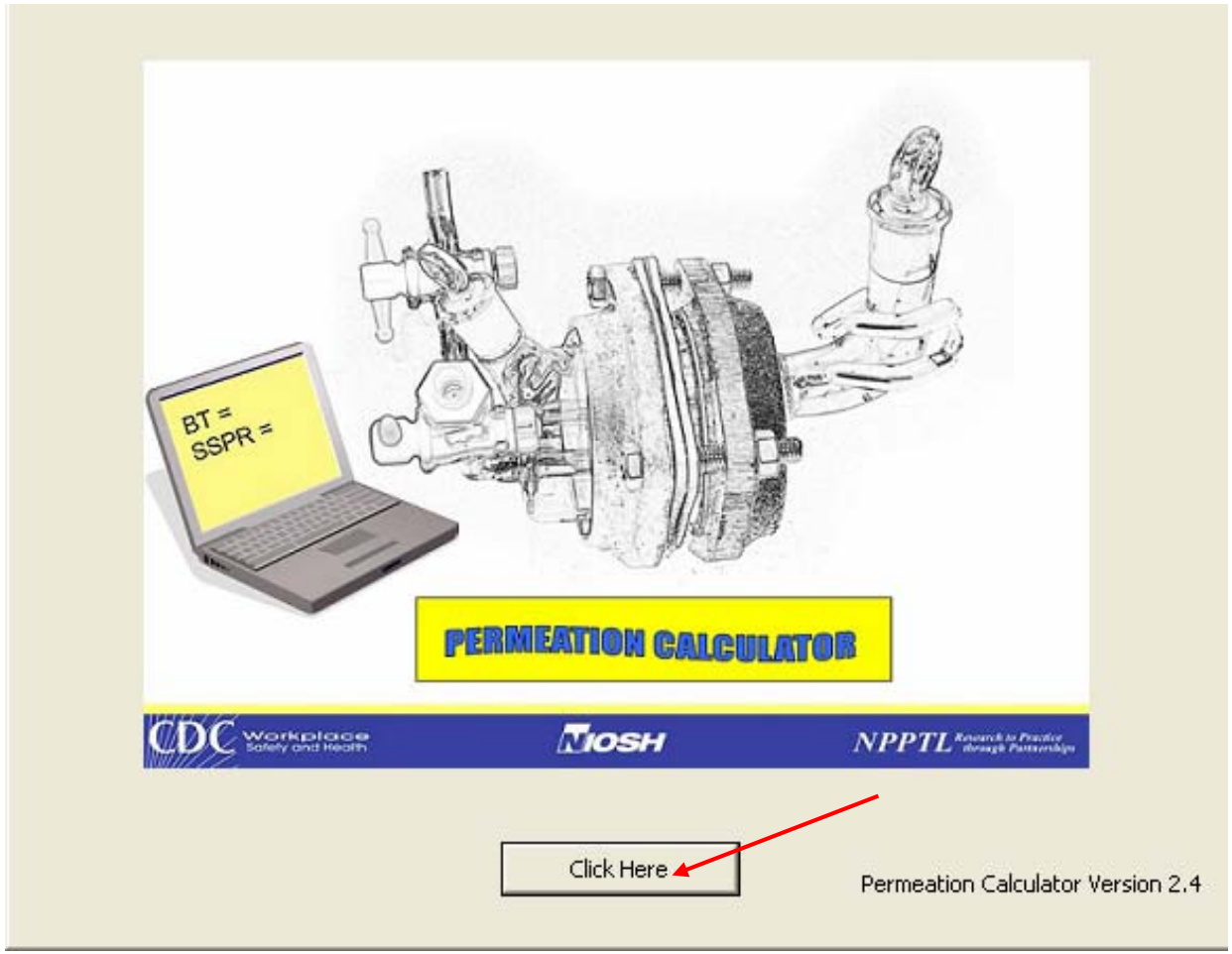
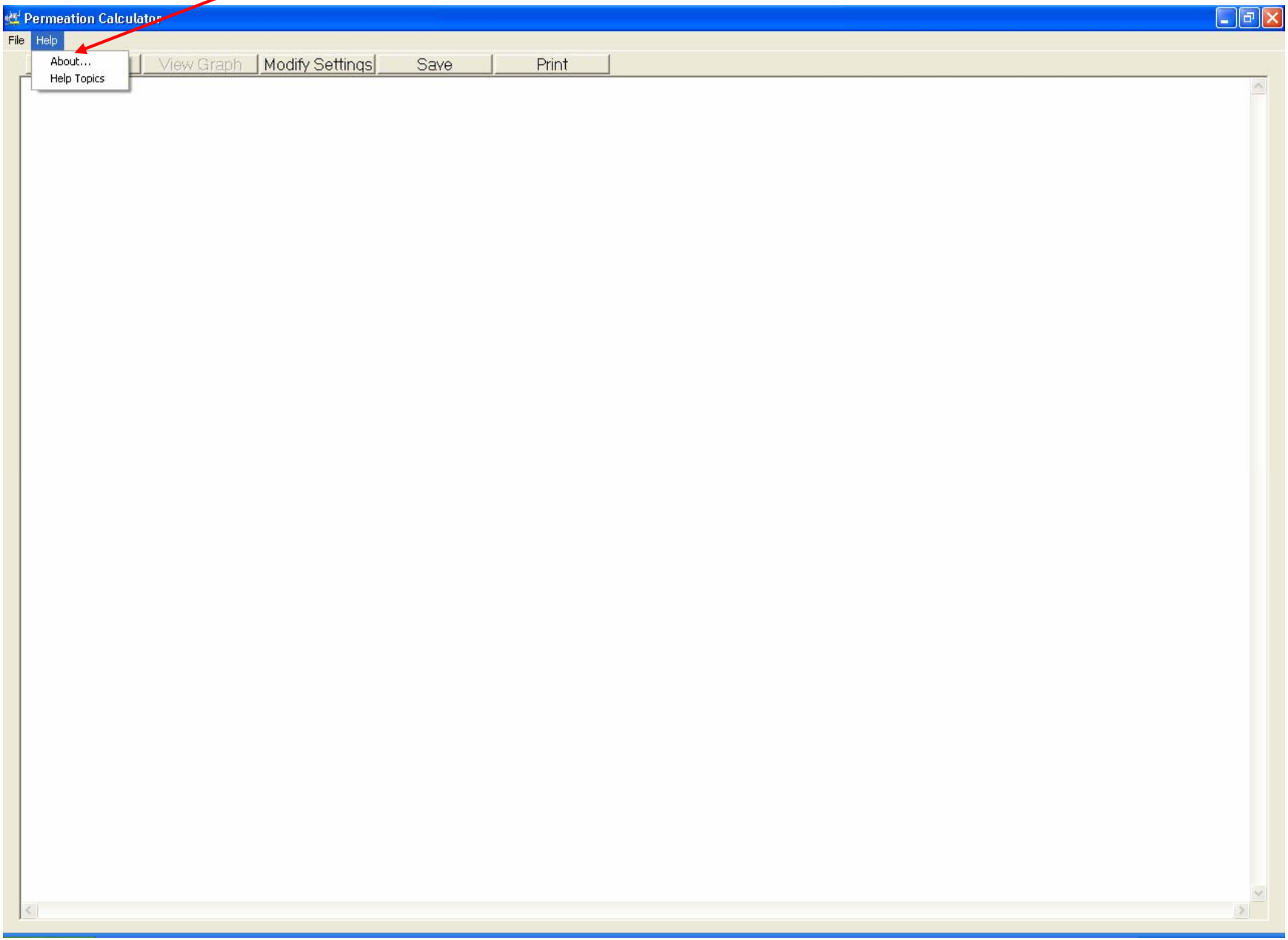
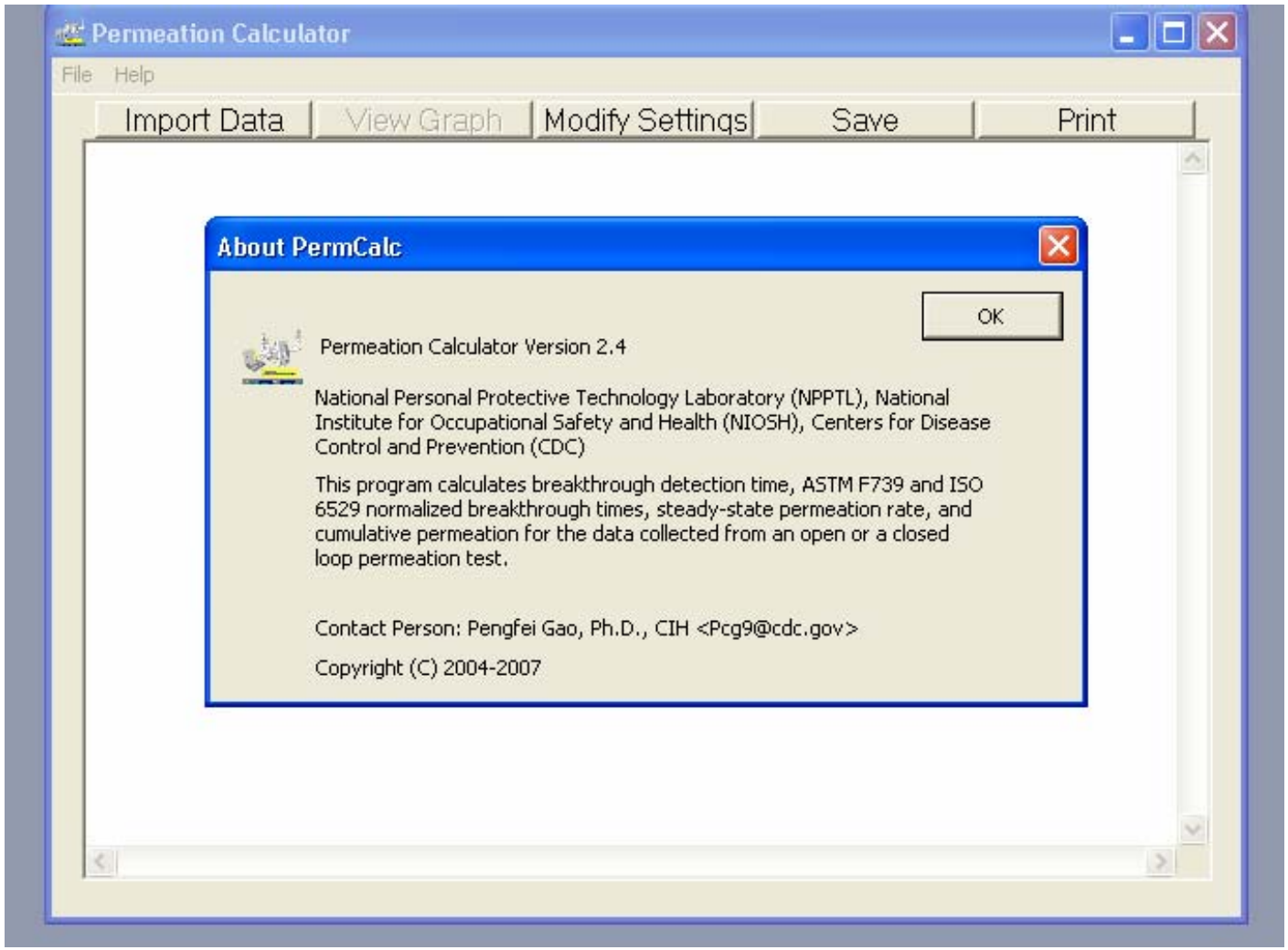
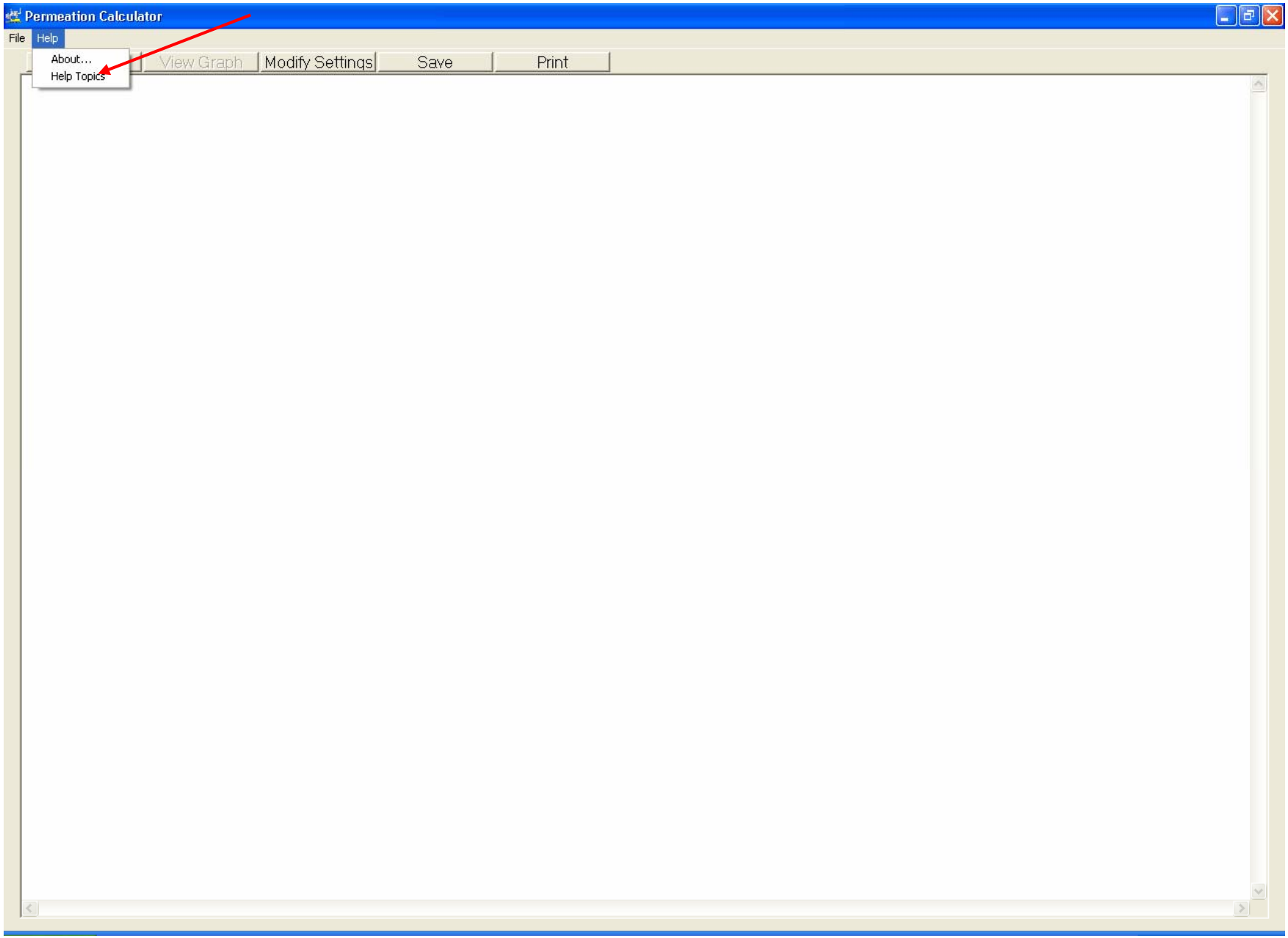
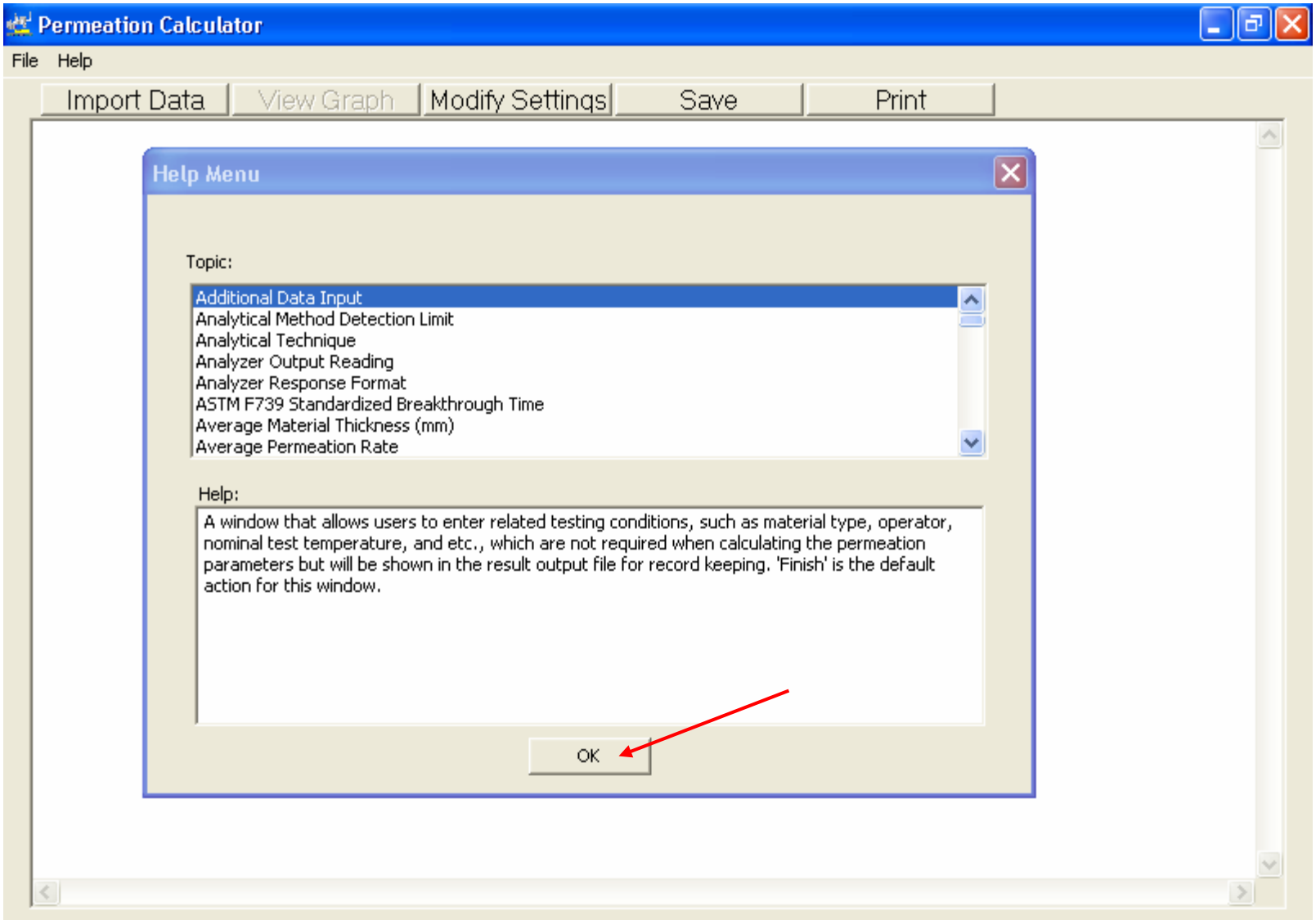
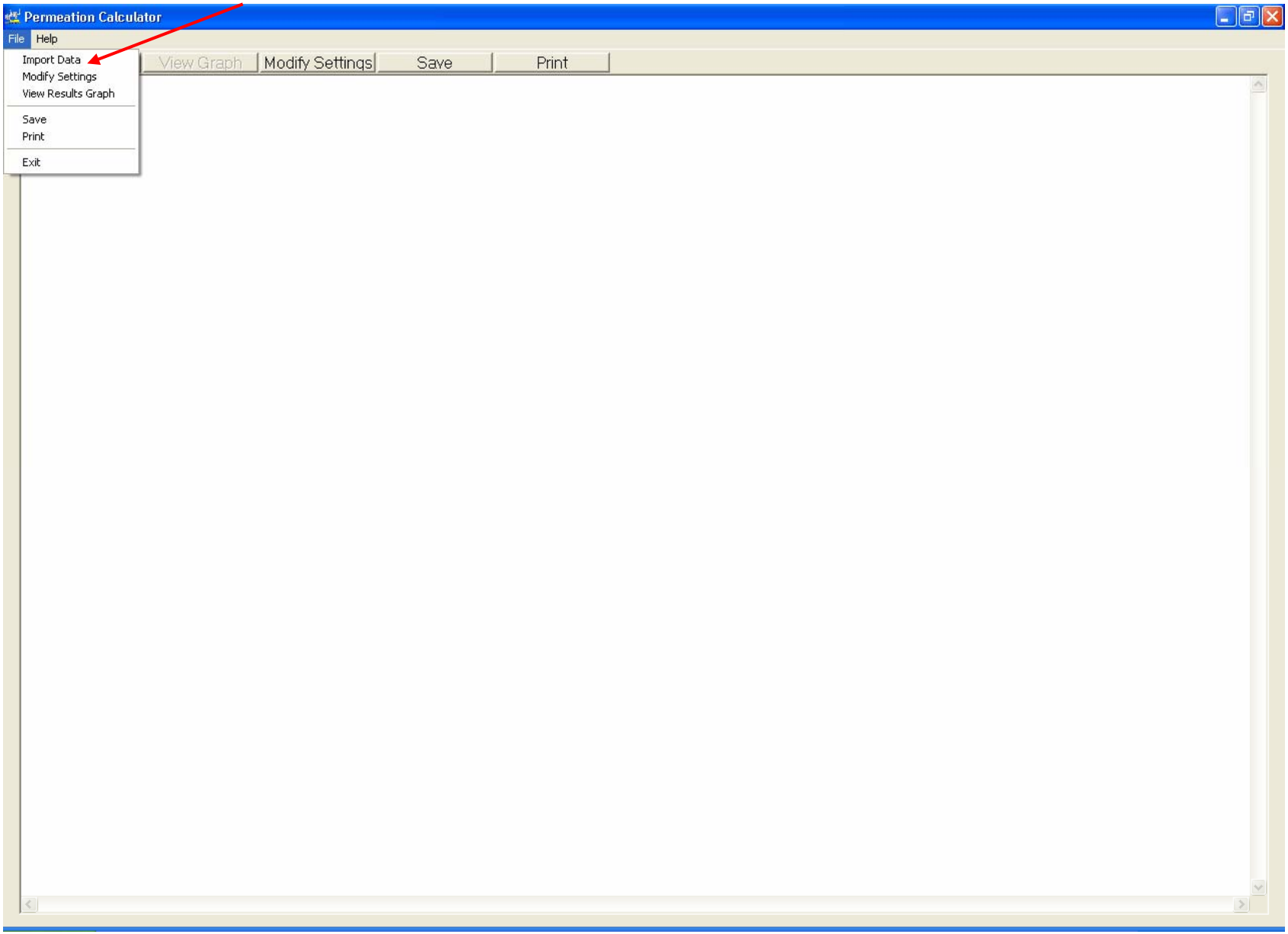

BT =
SSPR =
PERMEATION CALCULATOR
CDC Workplace Safety and Health
NIOSH
NPPTL
Click Here
Permeation Calculator Version 2.4

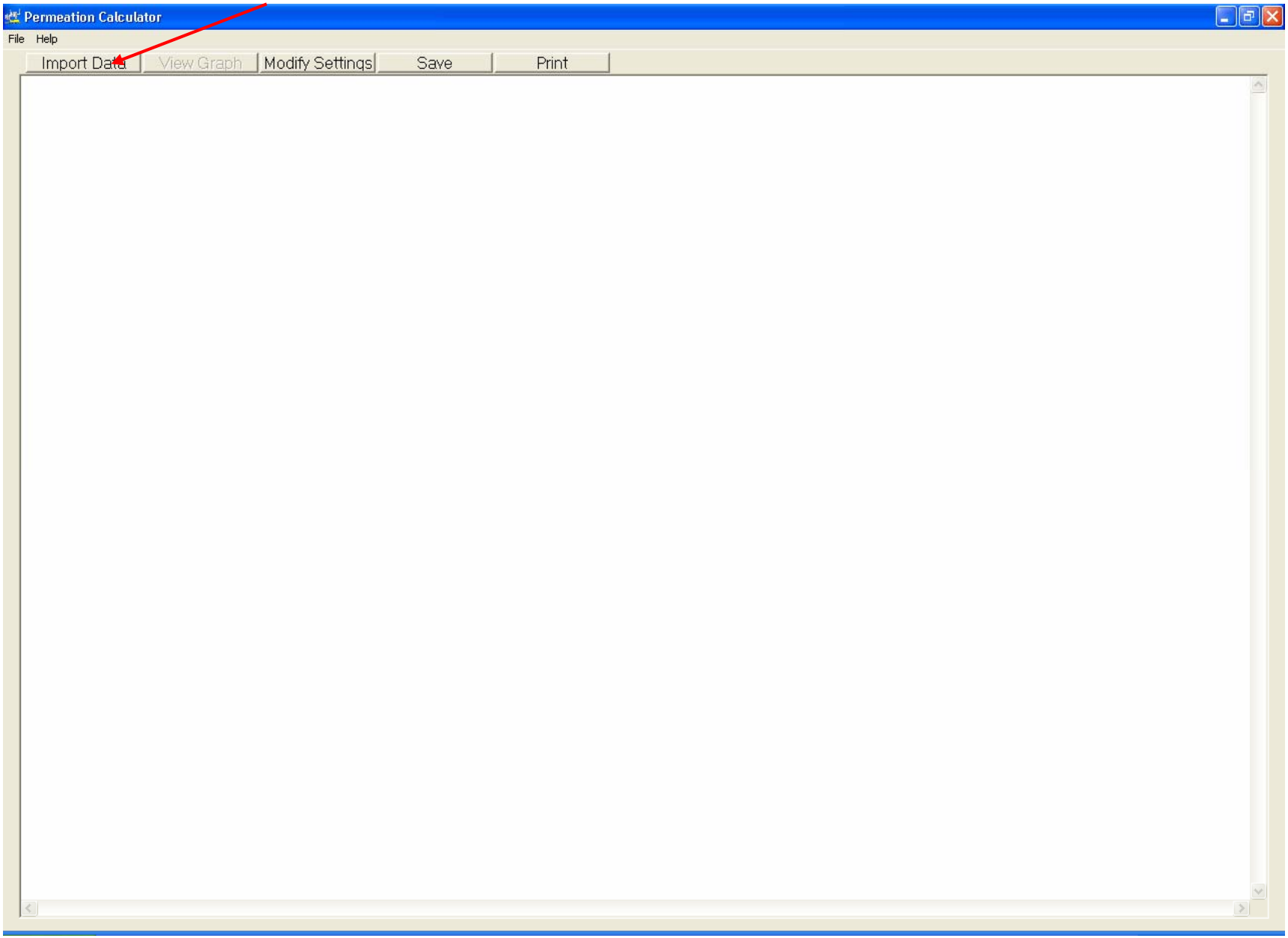

Permeation Calculator
File
Help
About...
Help Topics
View Graph
Modify Settings
Save
Print

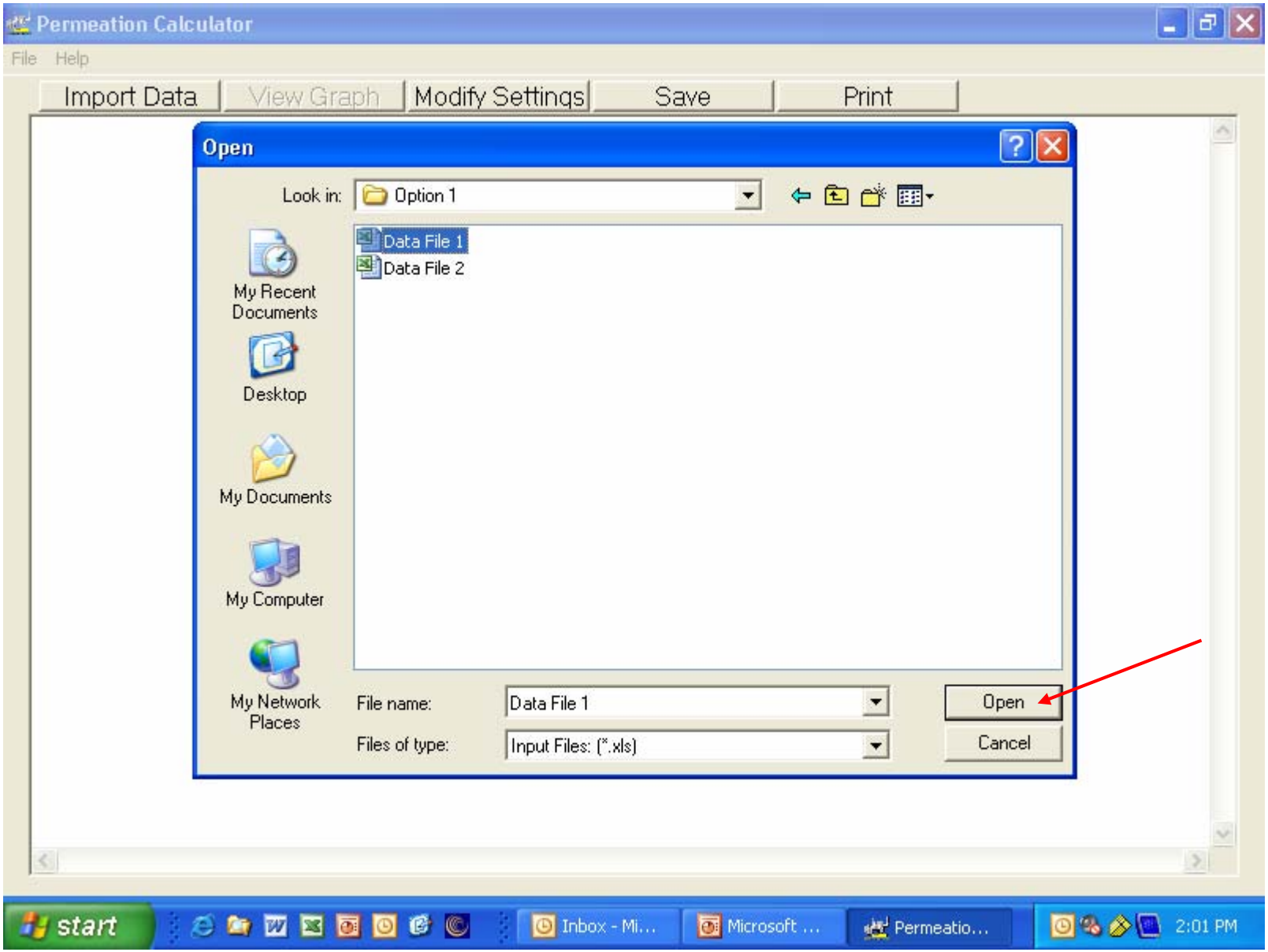

Permeation Calculator
File Help
Import Data
View Graph
Modify Settings
Save
Print
About PermCalc
OK
Permeation Calculator Version 2.4
National Personal Protective Technology Laboratory (NPPTL), National Institute for Occupational Safety and Health (NIOSH), Centers for Disease Control and Prevention (CDC)
This program calculates breakthrough detection time, ASTM F739 and ISO 6529 normalized breakthrough times, steady-state permeation rate, and cumulative permeation for the data collected from an open or a closed loop permeation test.
Contact Person: Pengfei Gao, Ph.D., CIH <Pcg9@cdc.gov>
Copyright (C) 2004-2007

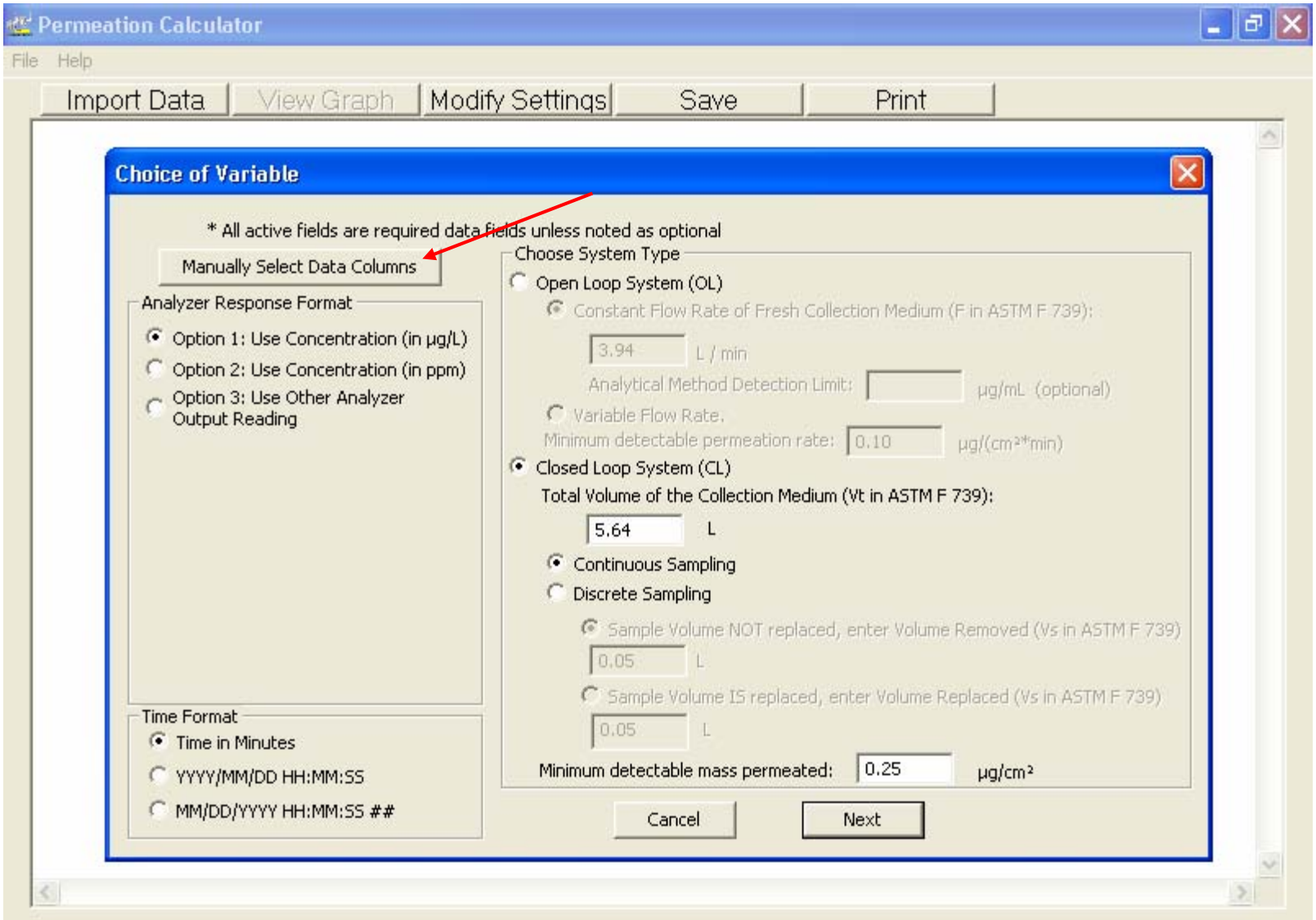

Permeation Calculator
File
Help
About...
Help Topics
View Graph
Modify Settings
Save
Print

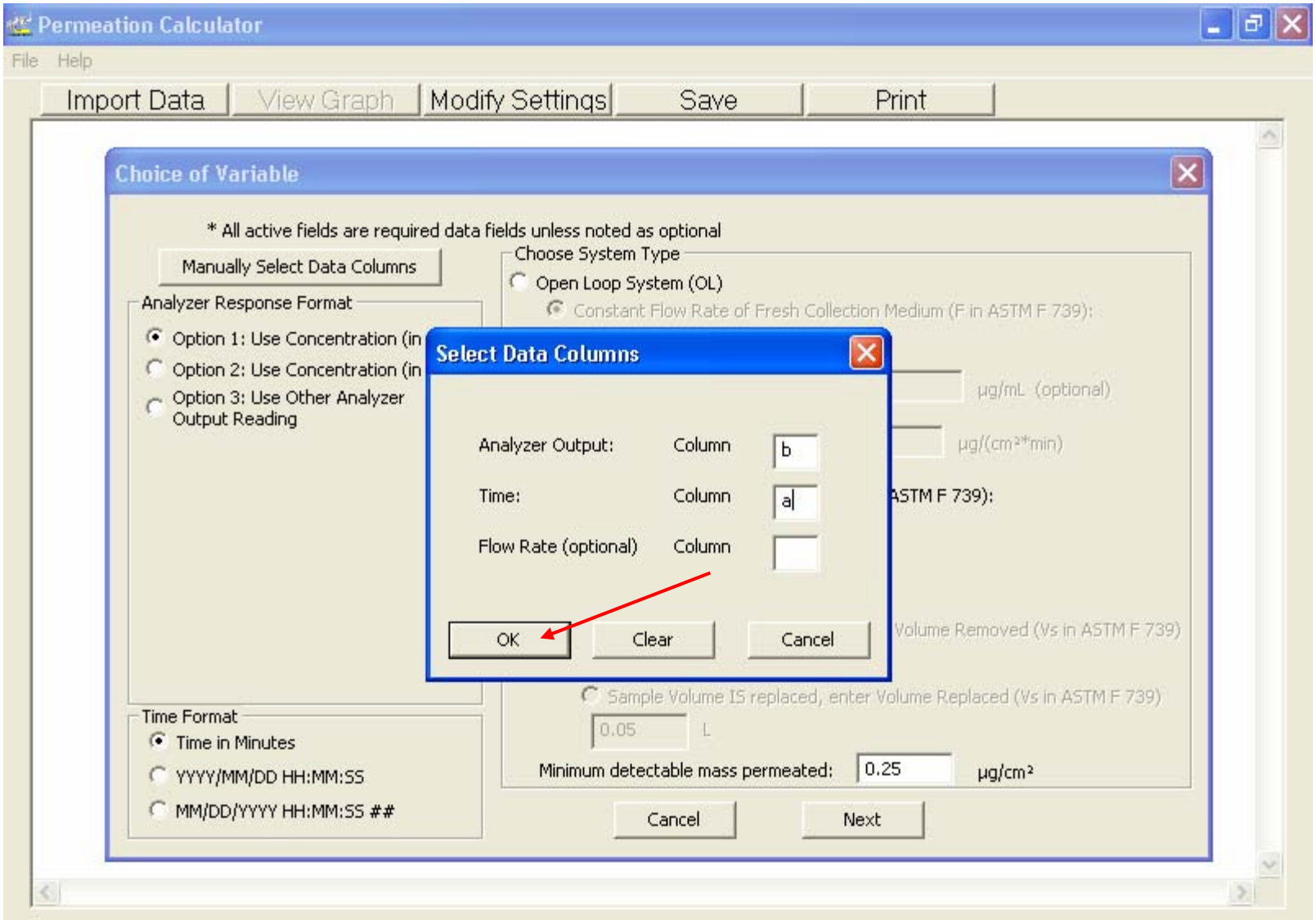

Permeation Calculator
File
Help
Import Data
View Graph
Modify Settings
Save
Print
Help Menu
Topic:
Additional Data Input
Analytical Method Detection Limit
Analytical Technique
Analyzer Output Reading
Analyzer Response Format
ASTM F739 Standardized Breakthrough Time
Average Material Thickness (mm)
Average Permeation Rate
Help:
A window that allows users to enter related testing conditions, such as material type, operator, nominal test temperature, and etc., which are not required when calculating the permeation parameters but will be shown in the result output file for record keeping. 'Finish' is the default action for this window.
OK

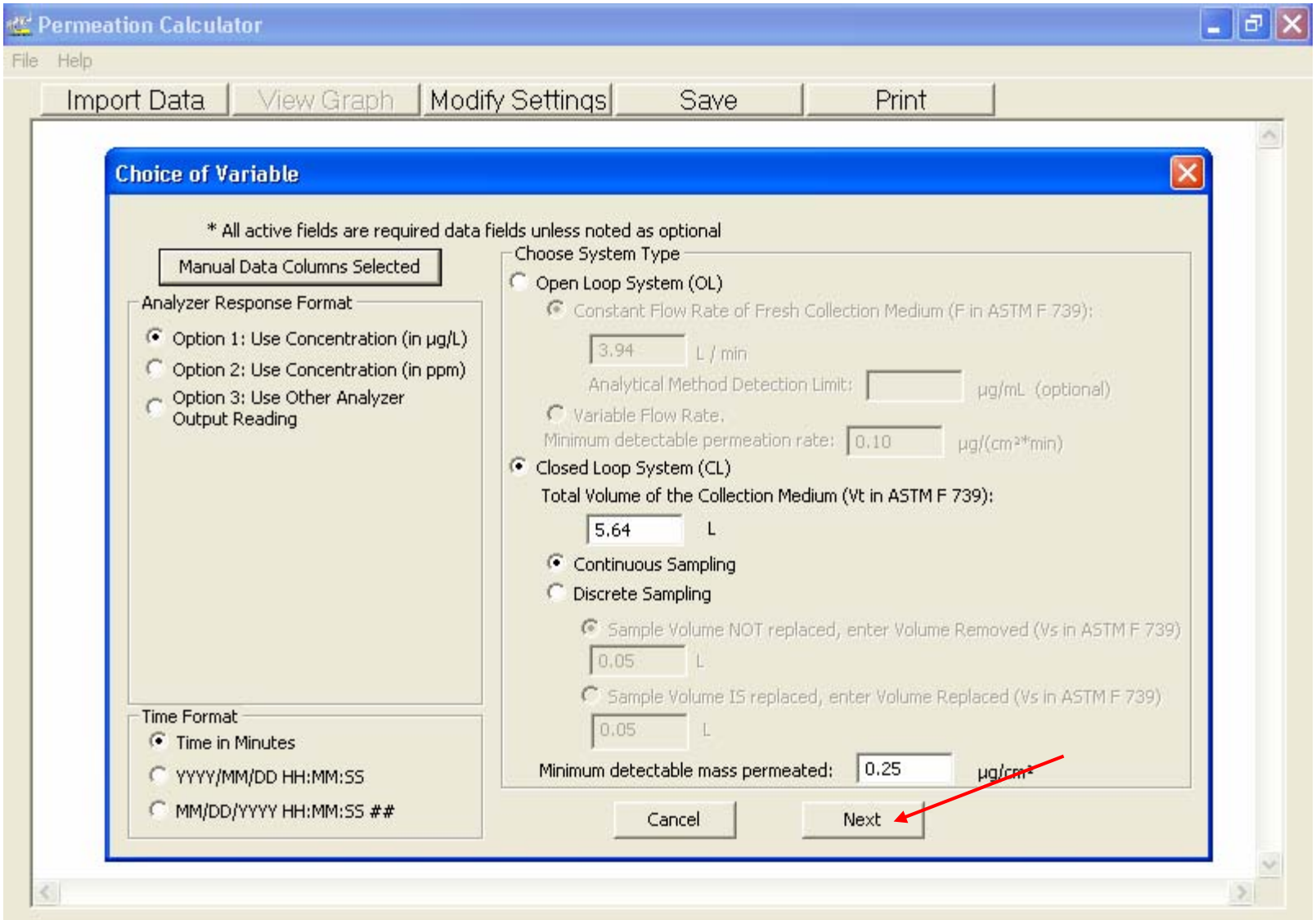

Permeation Calculator
File
Help
Import Data
Modify Settings
View Results Graph
Save
Print
Exit
View Graph
Modify Settings
Save
Print

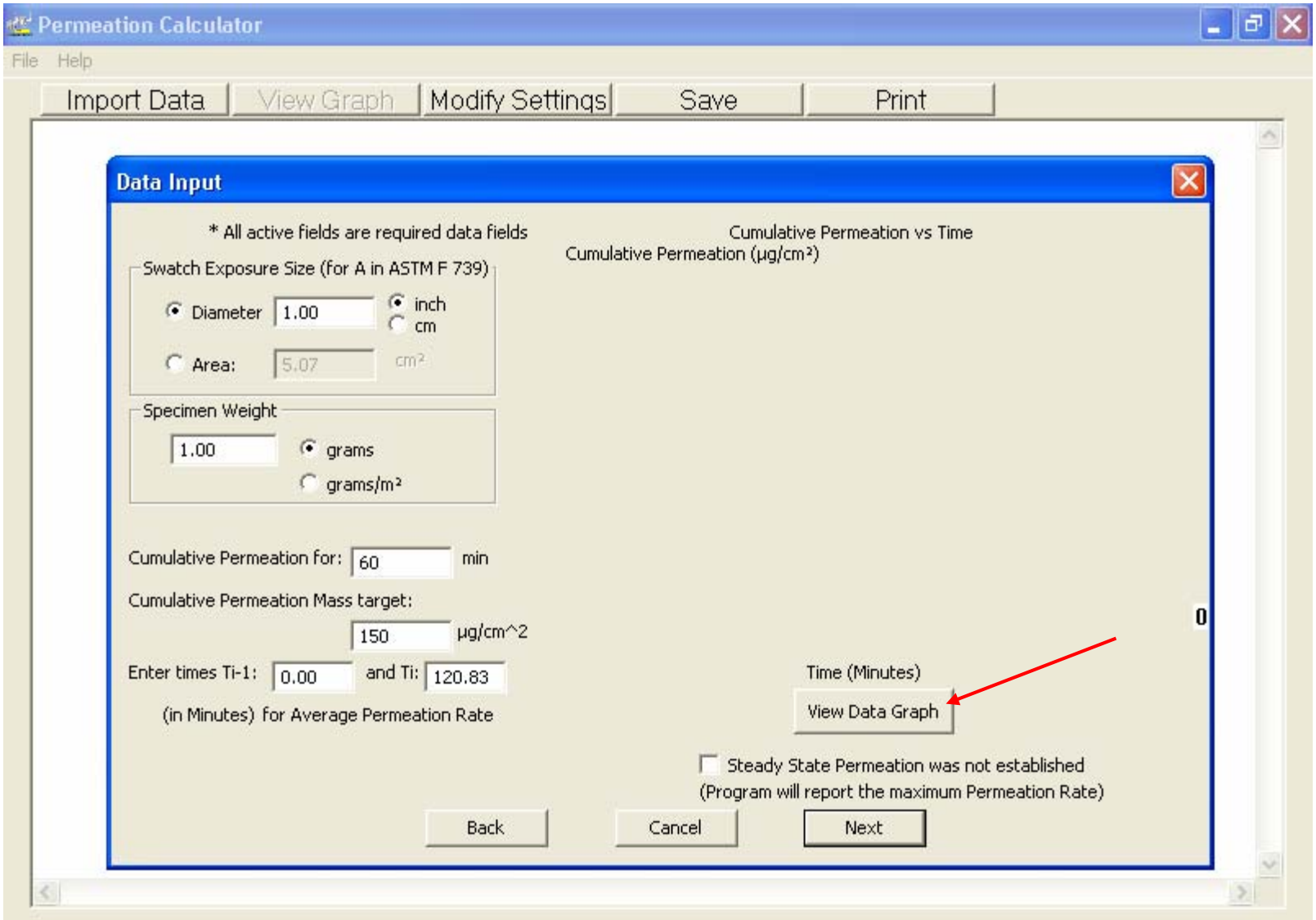

Permeation Calculator
File
Help
Import Data
View Graph
Modify Settings
Save
Print

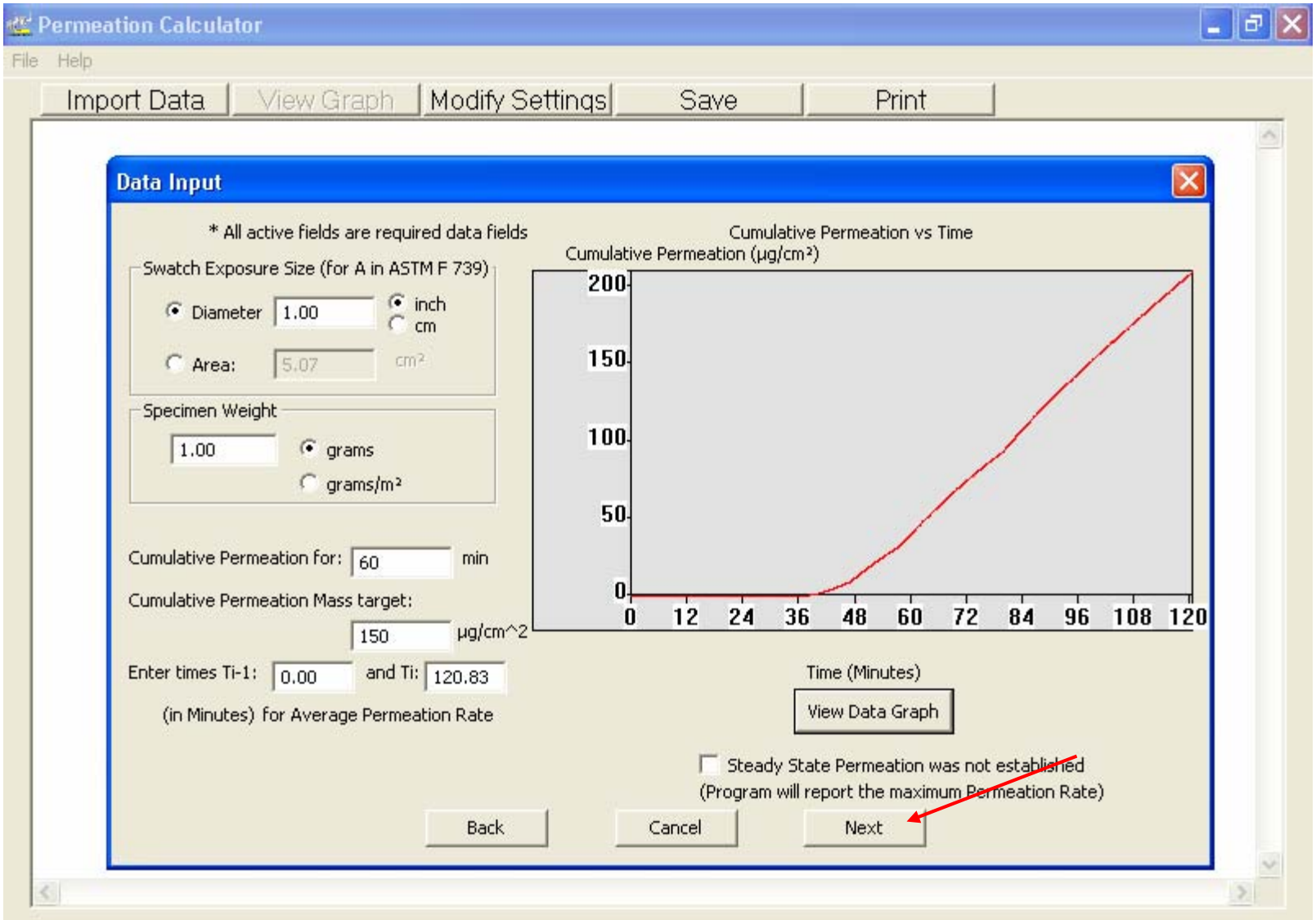

Permeation Calculator
File Help
Import Data
View Graph
Modify Settings
Save
Print
Open
Look in:
Option 1
Data File 1
Data File 2
My Recent Documents
Desktop
My Documents
My Computer
My Network Places
File name:
Data File 1
Files of type:
Input Files: (*.xls)
Open
Cancel
start
Inbox - Mi...
Microsoft ...
Permeatio...
2:01 PM

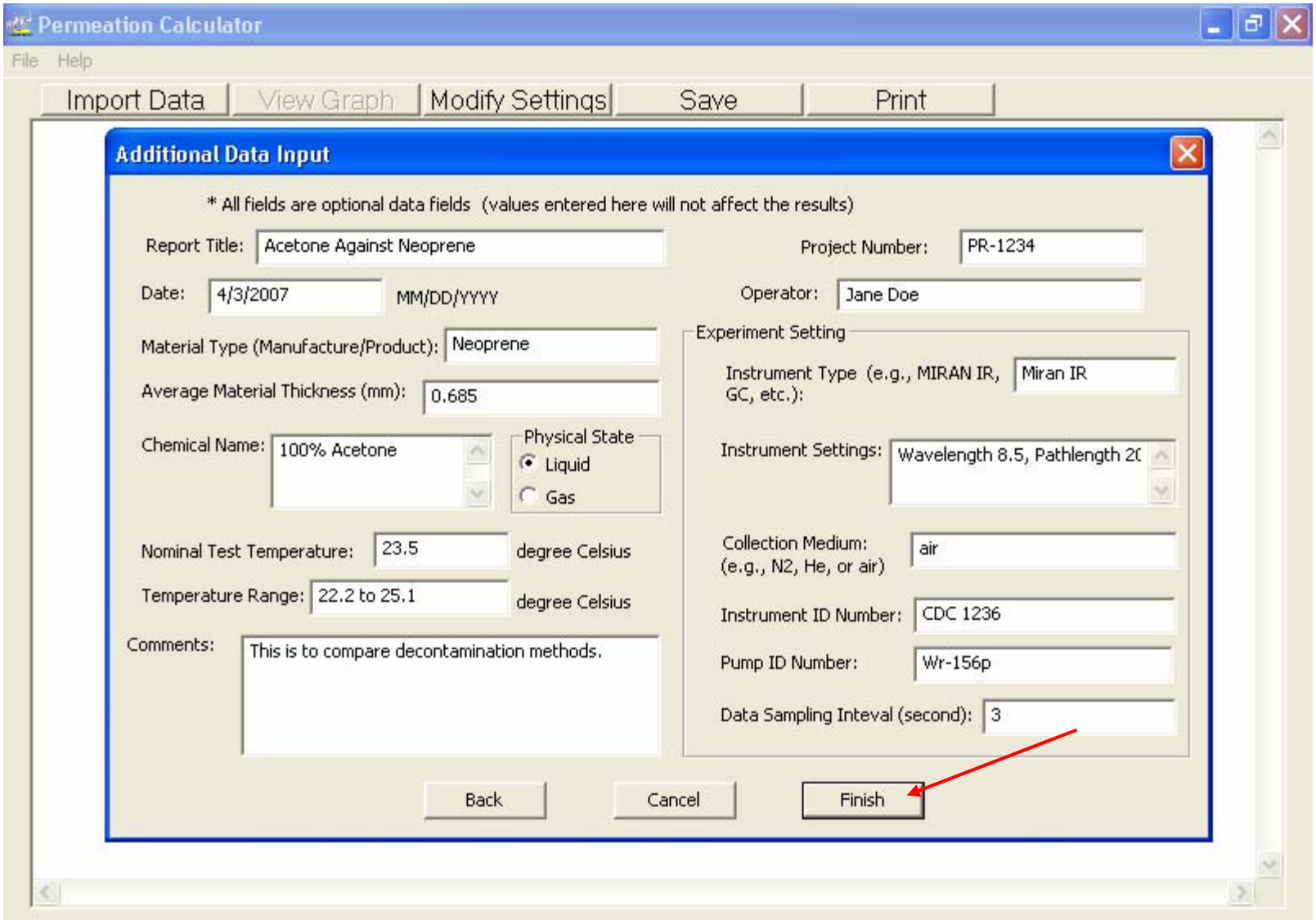

Permeation Calculator
File Help
Import Data
View Graph
Modify Settings
Save
Print
Choice of Variable
* All active fields are required data fields unless noted as optional
Manually Select Data Columns
Analyzer Response Format
Option 1: Use Concentration (in µg/L)
Option 2: Use Concentration (in ppm)
Option 3: Use Other Analyzer Output Reading
Time Format
Time in Minutes
YYYY/MM/DD HH:MM:SS
MM/DD/YYYY HH:MM:SS ##
Choose System Type
Open Loop System (OL)
Constant Flow Rate of Fresh Collection Medium (F in ASTM F 739):
3.94
L / min
Analytical Method Detection Limit:
µg/mL (optional)
Variable Flow Rate.
Minimum detectable permeation rate:
0.10
µg/(cm²*min)
Closed Loop System (CL)
Total Volume of the Collection Medium (Vt in ASTM F 739):
5.64
L
Continuous Sampling
Discrete Sampling
Sample Volume NOT replaced, enter Volume Removed (Vs in ASTM F 739)
0.05
L
Sample Volume IS replaced, enter Volume Replaced (Vs in ASTM F 739)
0.05
L
Minimum detectable mass permeated:
0.25
µg/cm²
Cancel
Next

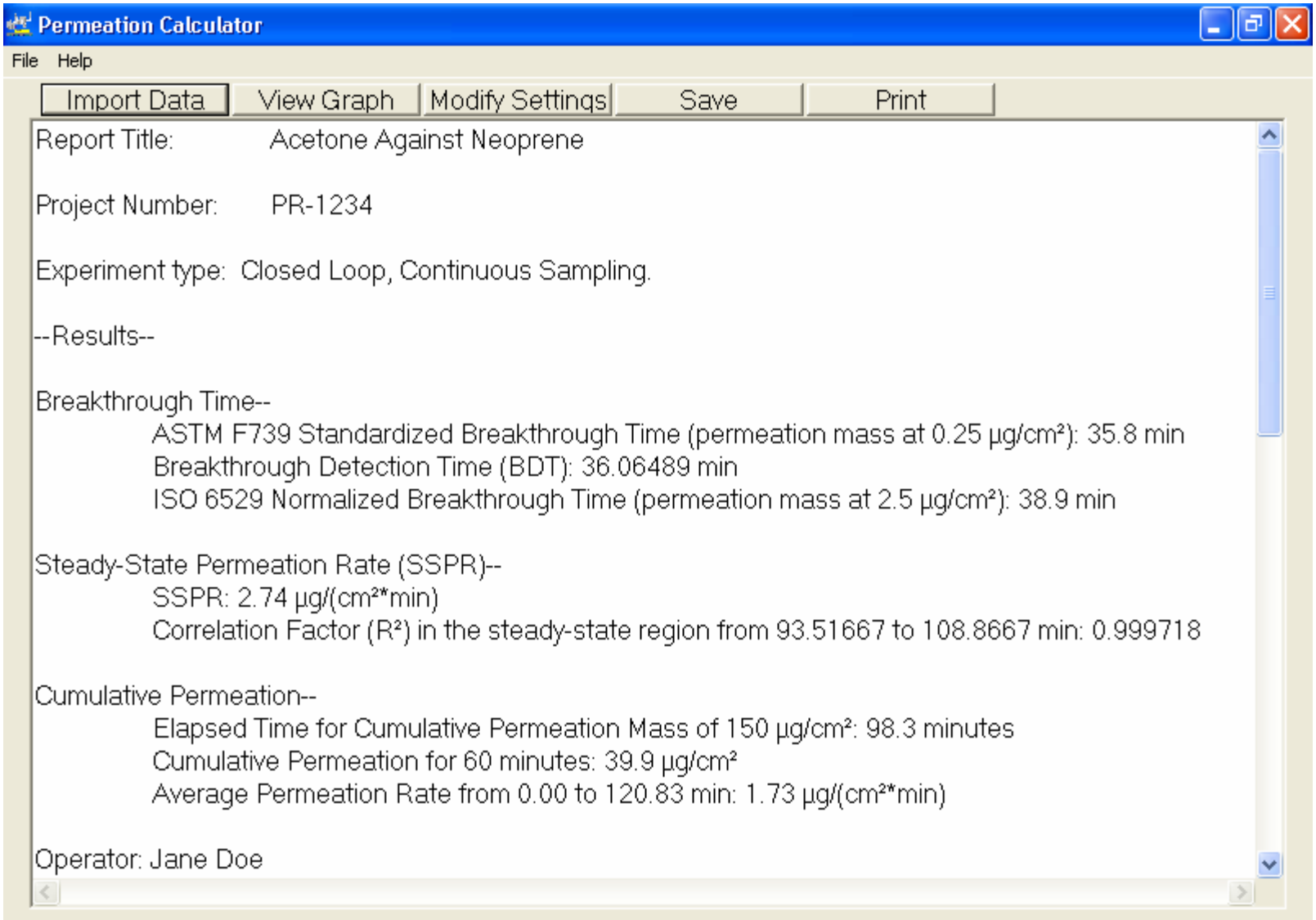

Permeation Calculator
File Help
Import Data
View Graph
Modify Settings
Save
Print
Choice of Variable
* All active fields are required data fields unless noted as optional
Manually Select Data Columns
Analyzer Response Format
Option 1: Use Concentration (in
Option 2: Use Concentration (in
Option 3: Use Other Analyzer Output Reading
Time Format
Time in Minutes
YYYY/MM/DD HH:MM:SS
MM/DD/YYYY HH:MM:SS ##
Choose System Type
Open Loop System (OL)
Constant Flow Rate of Fresh Collection Medium (F in ASTM F 739):
µg/mL (optional)
µg/(cm²*min)
ASTM F 739):
Volume Removed (Vs in ASTM F 739)
Sample Volume IS replaced, enter Volume Replaced (Vs in ASTM F 739)
0.05
L
Minimum detectable mass permeated:
0.25
µg/cm²
Cancel
Next
Select Data Columns
Analyzer Output: Column b
Time: Column a
Flow Rate (optional) Column
OK
Clear
Cancel

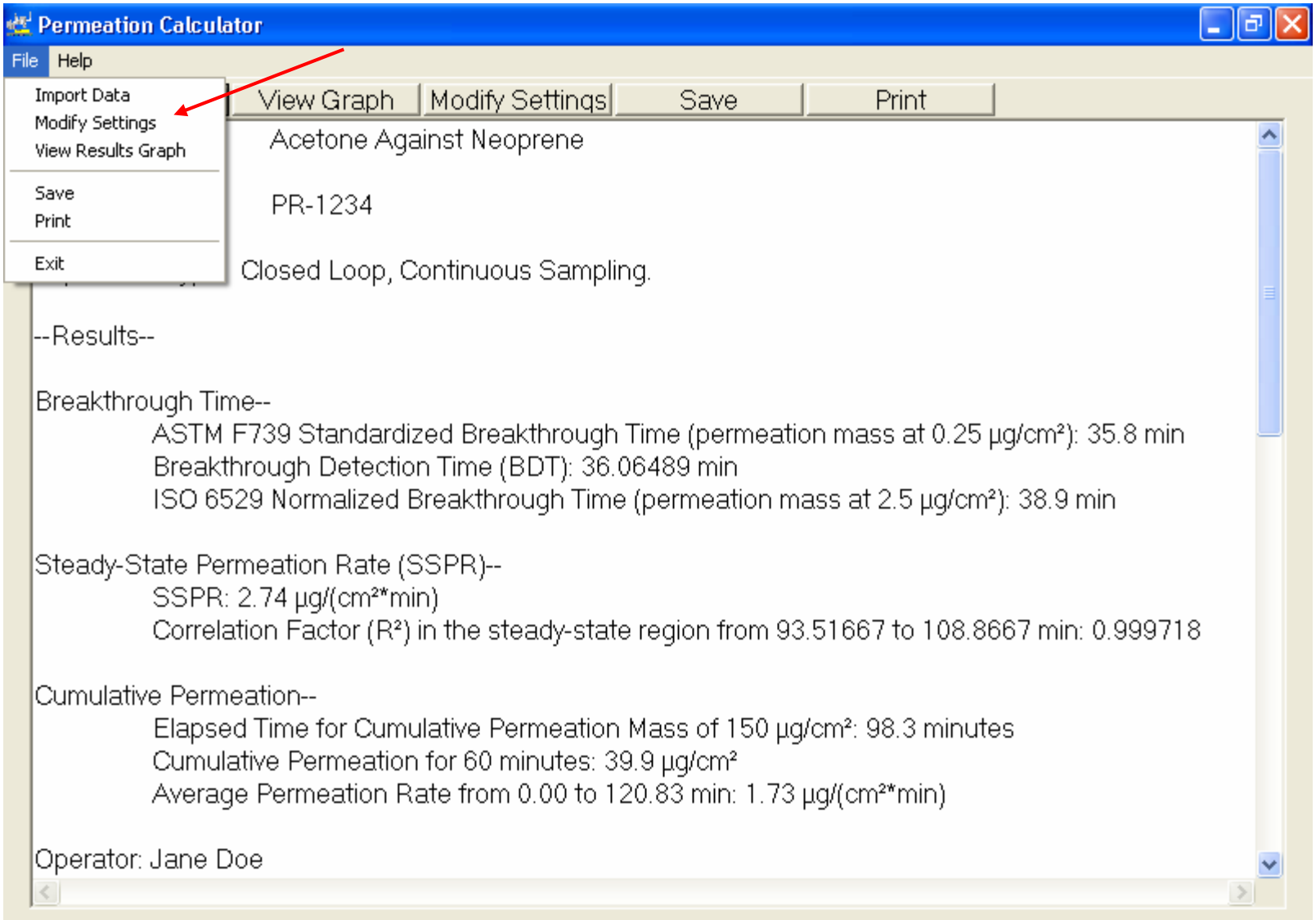

Permeation Calculator
File Help
Import Data
View Graph
Modify Settings
Save
Print
Choice of Variable
* All active fields are required data fields unless noted as optional
Manual Data Columns Selected
Analyzer Response Format
Option 1: Use Concentration (in µg/L)
Option 2: Use Concentration (in ppm)
Option 3: Use Other Analyzer Output Reading
Time Format
Time in Minutes
YYYY/MM/DD HH:MM:SS
MM/DD/YYYY HH:MM:SS ##
Choose System Type
Open Loop System (OL)
Constant Flow Rate of Fresh Collection Medium (F in ASTM F 739):
3.94
L / min
Analytical Method Detection Limit:
µg/mL (optional)
Variable Flow Rate.
Minimum detectable permeation rate:
0.10
µg/(cm²*min)
Closed Loop System (CL)
Total Volume of the Collection Medium (Vt in ASTM F 739):
5.64
L
Continuous Sampling
Discrete Sampling
Sample Volume NOT replaced, enter Volume Removed (Vs in ASTM F 739)
0.05
L
Sample Volume IS replaced, enter Volume Replaced (Vs in ASTM F 739)
0.05
L
Minimum detectable mass permeated:
0.25
µg/cm²
Cancel
Next


Permeation Calculator
File Help
Import Data
View Graph
Modify Settings
Save
Print
Data Input
* All active fields are required data fields
Swatch Exposure Size (for A in ASTM F 739)
Diameter 1.00
inch
cm
Area: 5.07 cm²
Specimen Weight
1.00
grams
grams/m²
Cumulative Permeation for: 60 min
Cumulative Permeation Mass target:
150 µg/cm^2
Enter times Ti-1: 0.00 and Ti: 120.83
(in Minutes) for Average Permeation Rate
Cumulative Permeation vs Time
Cumulative Permeation (µg/cm²)
0
Time (Minutes)
View Data Graph
Steady State Permeation was not established
(Program will report the maximum Permeation Rate)
Back
Cancel
Next


Permeation Calculator
File Help
Import Data
View Graph
Modify Settings
Save
Print
Data Input
* All active fields are required data fields
Swatch Exposure Size (for A in ASTM F 739)
Diameter 1.00
inch
cm
Area: 5.07 cm²
Specimen Weight
1.00
grams
grams/m²
Cumulative Permeation for: 60 min
Cumulative Permeation Mass target:
150 µg/cm^2
Enter times Ti-1: 0.00 and Ti: 120.83
(in Minutes) for Average Permeation Rate
Cumulative Permeation vs Time
Cumulative Permeation (µg/cm²)
200
150
100
50
0
0 12 24 36 48 60 72 84 96 108 120
Time (Minutes)
View Data Graph
Steady State Permeation was not established
(Program will report the maximum Permeation Rate)
Back
Cancel
Next


Permeation Calculator
File Help
Import Data
View Graph
Modify Settings
Save
Print
Additional Data Input
* All fields are optional data fields (values entered here will not affect the results)
Report Title: Acetone Against Neoprene
Project Number: PR-1234
Date: 4/3/2007
MM/DD/YYYY
Operator: Jane Doe
Material Type (Manufacture/Product): Neoprene
Average Material Thickness (mm): 0.685
Chemical Name: 100% Acetone
Physical State
Liquid
Gas
Nominal Test Temperature: 23.5
degree Celsius
Temperature Range: 22.2 to 25.1
degree Celsius
Comments: This is to compare decontamination methods.
Experiment Setting
Instrument Type (e.g., MIRAN IR, GC, etc.): Miran IR
Instrument Settings: Wavelength 8.5, Pathlength 2(
Collection Medium: (e.g., N2, He, or air) air
Instrument ID Number: CDC 1236
Pump ID Number: Wr-156p
Data Sampling Inteval (second): 3
Back
Cancel
Finish


Permeation Calculator
File Help
Import Data
View Graph
Modify Settings
Save
Print
Report Title: Acetone Against Neoprene
Project Number: PR-1234
Experiment type: Closed Loop, Continuous Sampling.
--Results--
Breakthrough Time--
ASTM F739 Standardized Breakthrough Time (permeation mass at 0.25 µg/cm²): 35.8 min
Breakthrough Detection Time (BDT): 36.06489 min
ISO 6529 Normalized Breakthrough Time (permeation mass at 2.5 µg/cm²): 38.9 min
Steady-State Permeation Rate (SSPR)--
SSPR: 2.74 µg/(cm²*min)
Correlation Factor (R²) in the steady-state region from 93.51667 to 108.8667 min: 0.999718
Cumulative Permeation--
Elapsed Time for Cumulative Permeation Mass of 150 µg/cm²: 98.3 minutes
Cumulative Permeation for 60 minutes: 39.9 µg/cm²
Average Permeation Rate from 0.00 to 120.83 min: 1.73 µg/(cm²*min)
Operator: Jane Doe


Permeation Calculator
File
Help
Import Data
Modify Settings
View Results Graph
Save
Print
Exit
View Graph
Modify Settings
Save
Print
Acetone Against Neoprene
PR-1234
Closed Loop, Continuous Sampling.
--Results--
Breakthrough Time--
ASTM F739 Standardized Breakthrough Time (permeation mass at 0.25 µg/cm²): 35.8 min
Breakthrough Detection Time (BDT): 36.06489 min
ISO 6529 Normalized Breakthrough Time (permeation mass at 2.5 µg/cm²): 38.9 min
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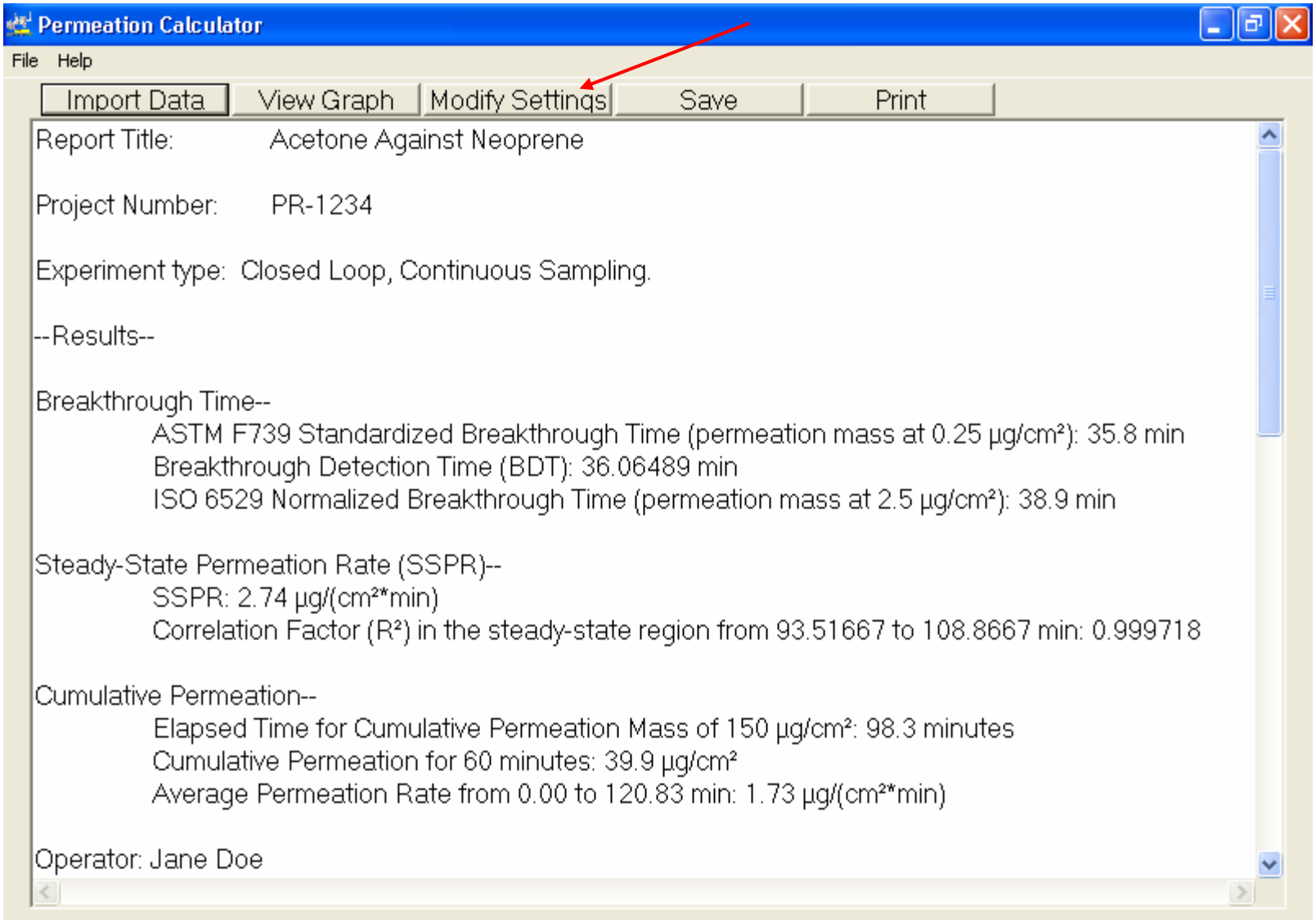
Average Permeation Rate from 0.00 to 120.83 min: 1.73 µg/(cm²*min)
Operator: Jane Doe


Permeation Calculator
File Help
Import Data
View Graph
Modify Settings
Save
Print
Report Title: Acetone Against Neoprene
Project Number: PR-1234
Experiment type: Closed Loop, Continuous Sampling.
--Results--
Breakthrough Time--
ASTM F739 Standardized Breakthrough Time (permeation mass at 0.25 µg/cm²): 35.8 min
Breakthrough Detection Time (BDT): 36.06489 min
ISO 6529 Normalized Breakthrough Time (permeation mass at 2.5 µg/cm²): 38.9 min
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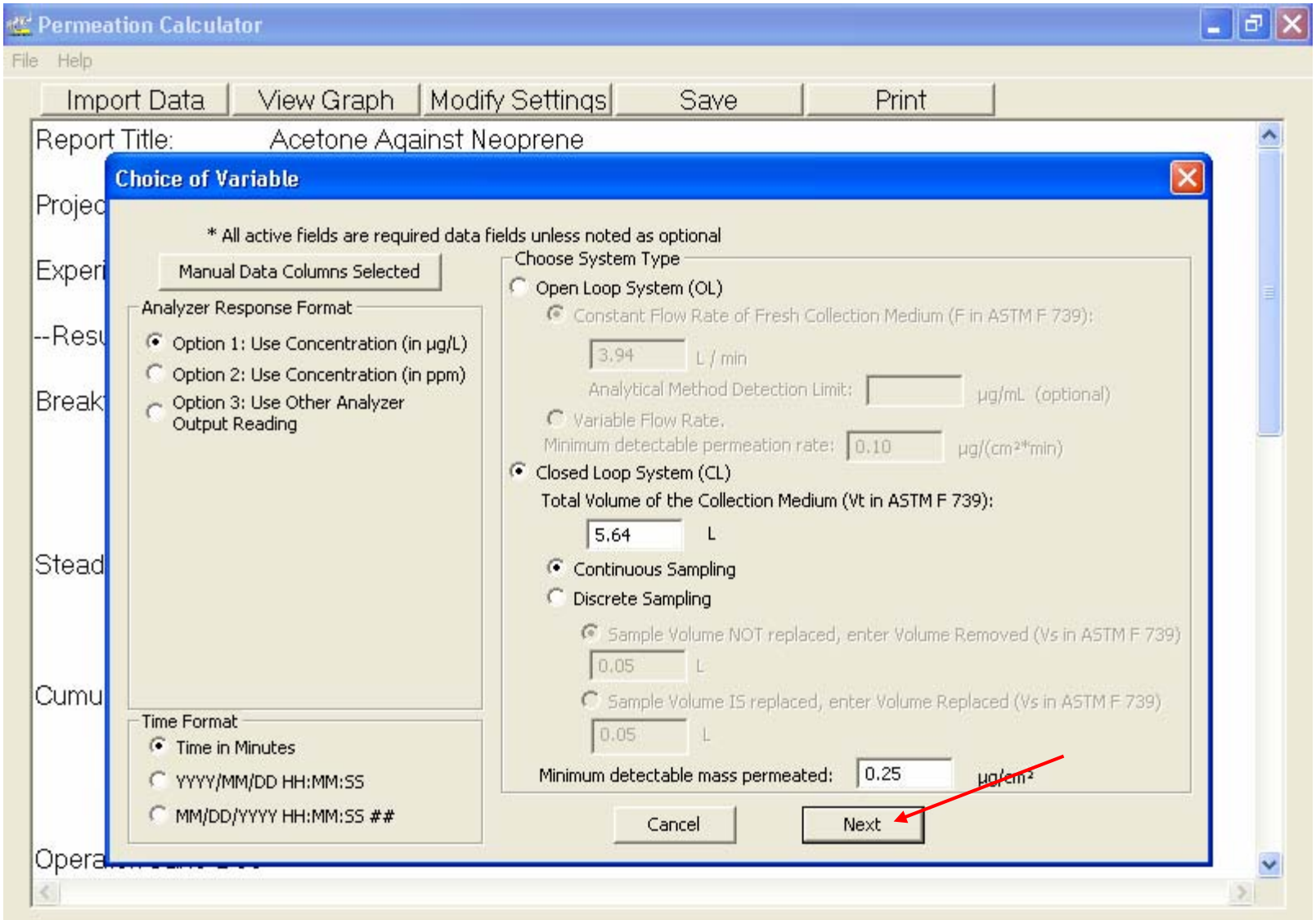
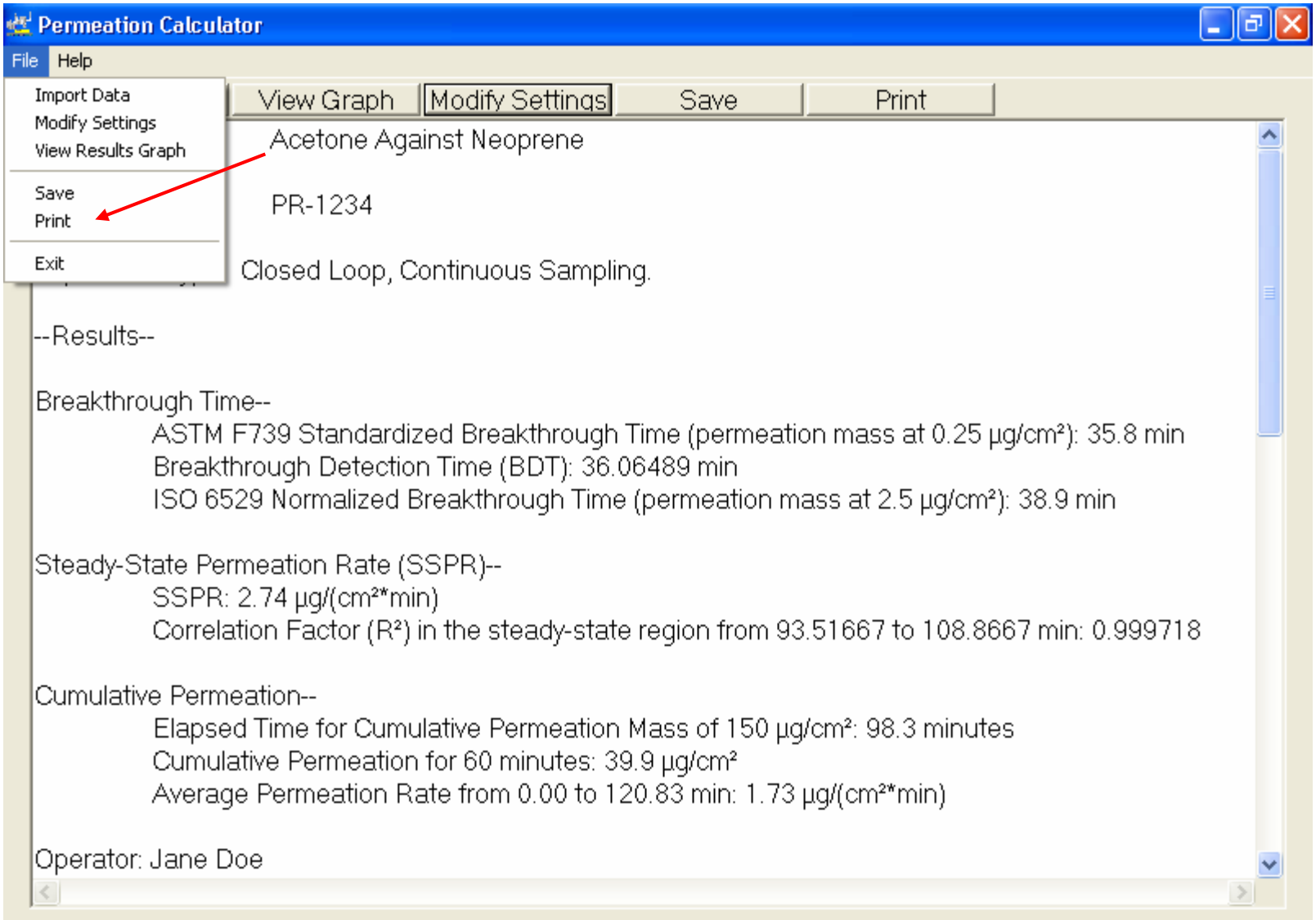
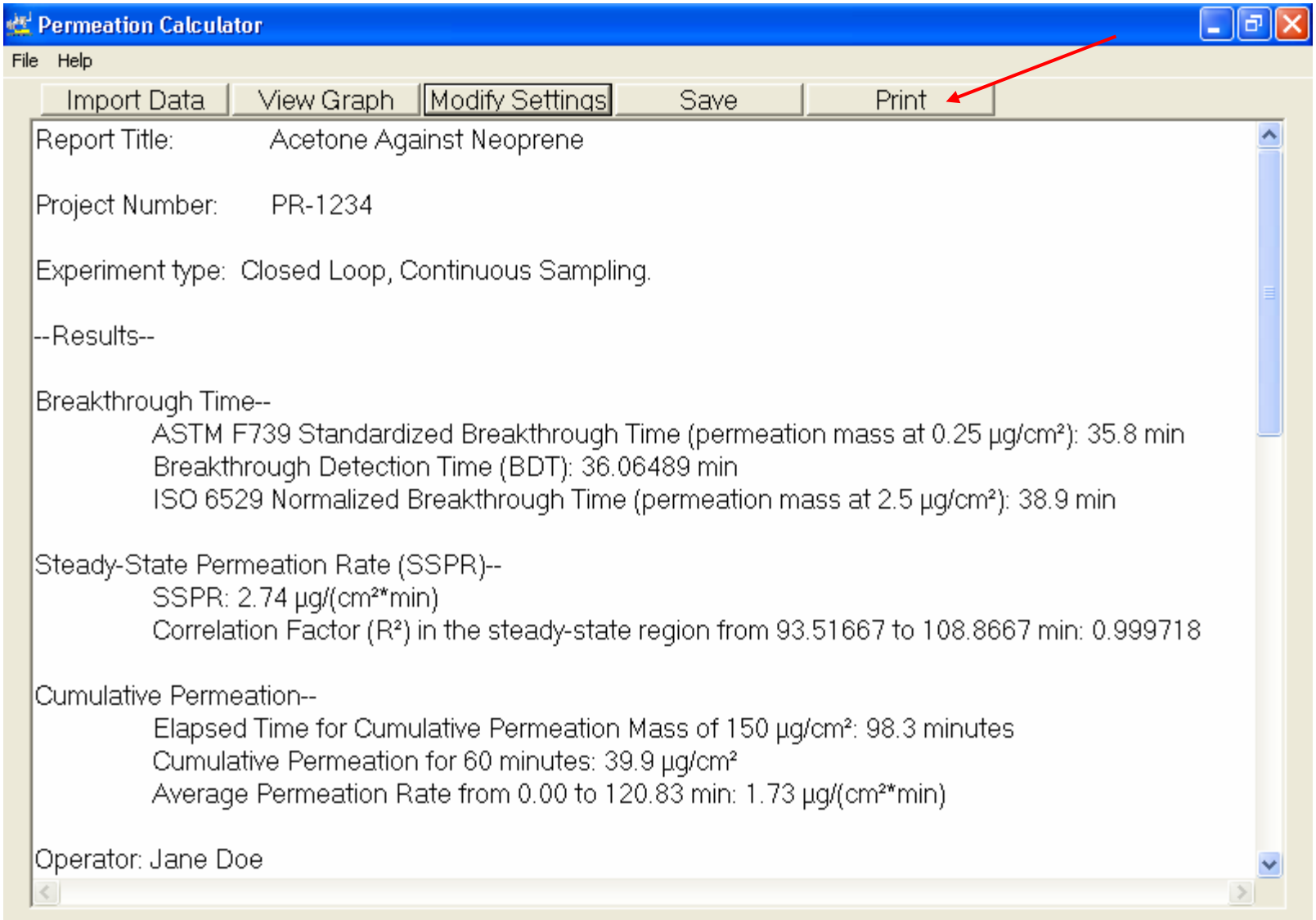
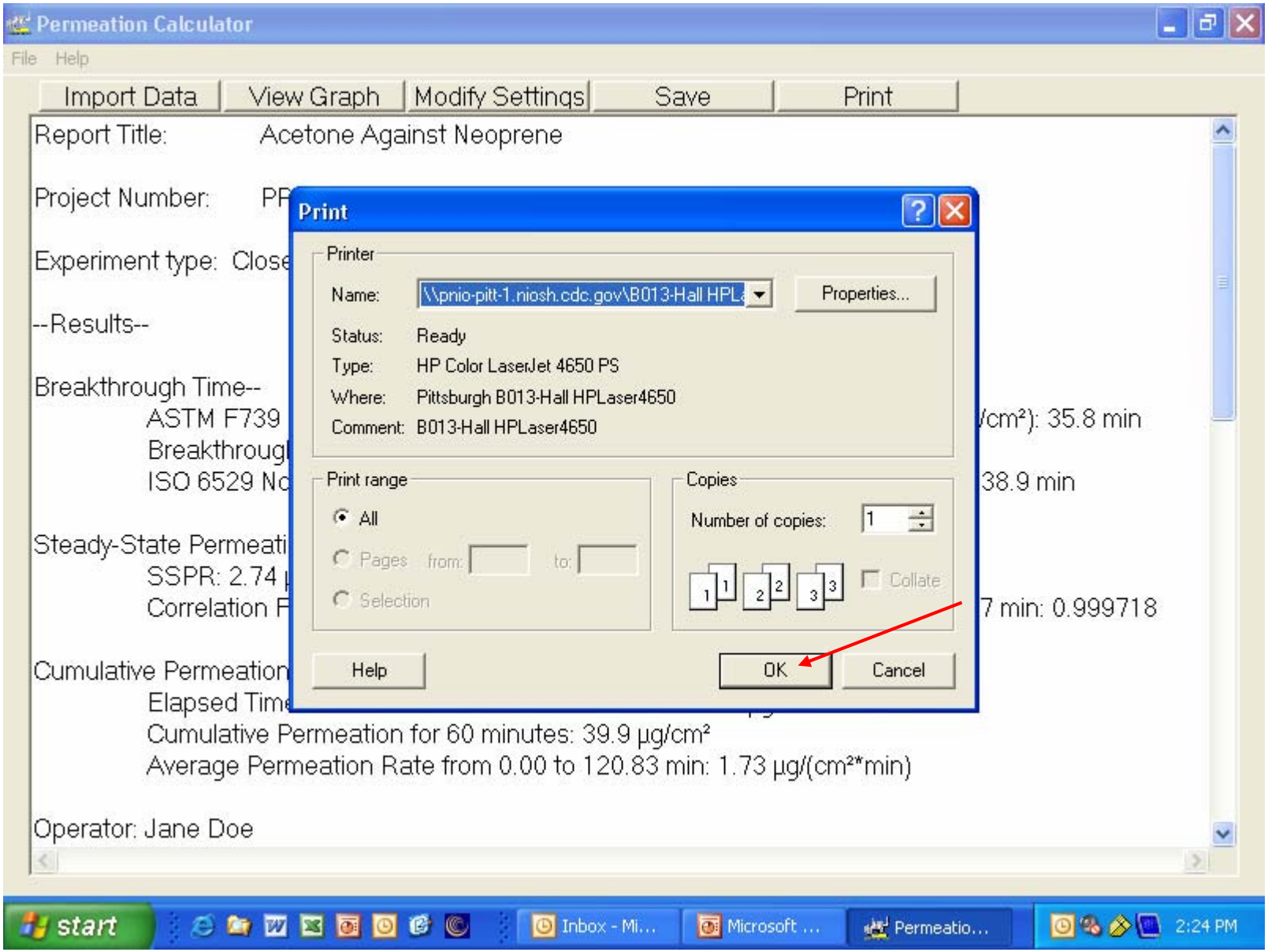
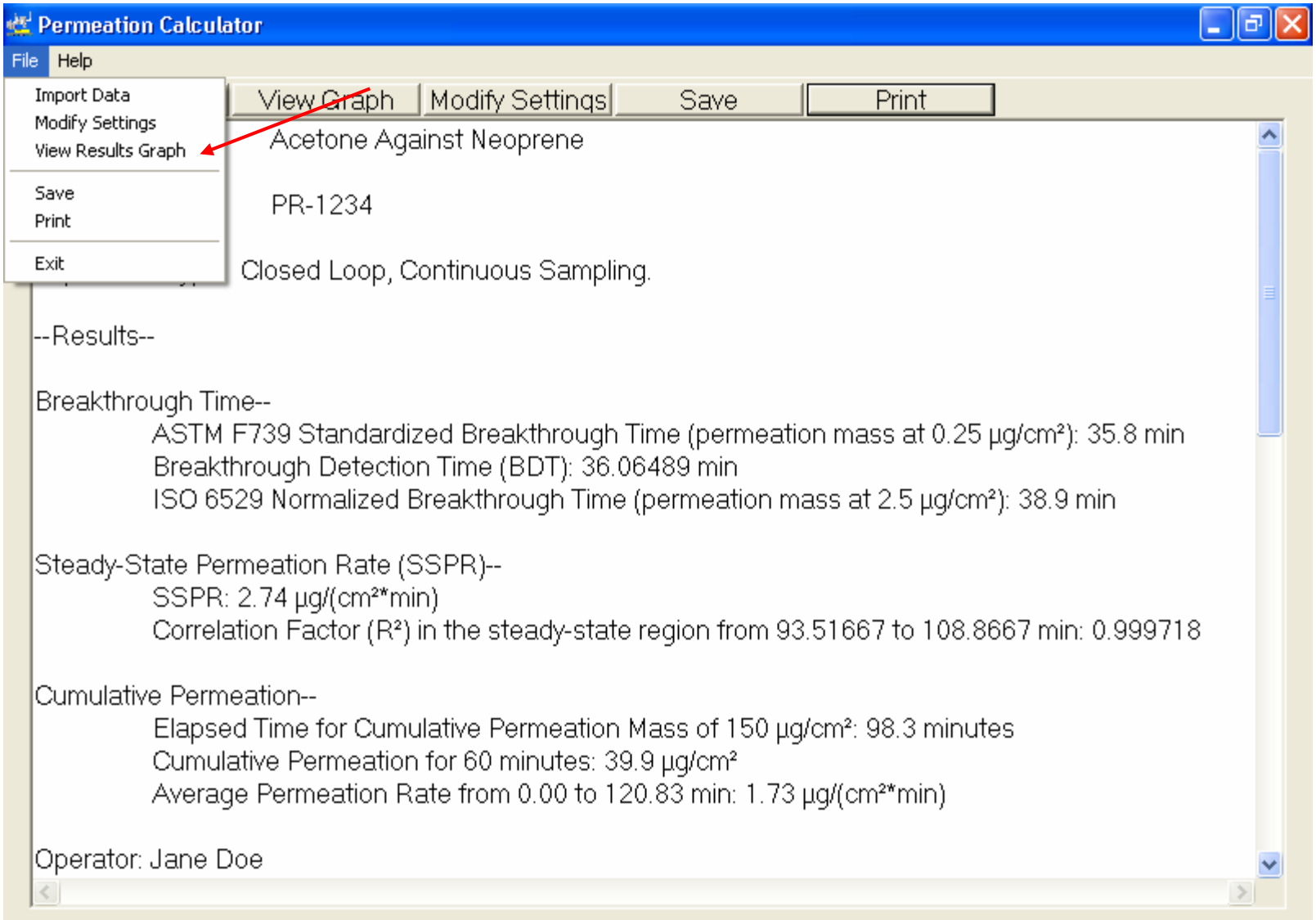
Cumulative Permeation for 60 minutes: 39.9 µg/cm²
Average Permeation Rate from 0.00 to 120.83 min: 1.73 µg/(cm²*min)
Operator: Jane Doe

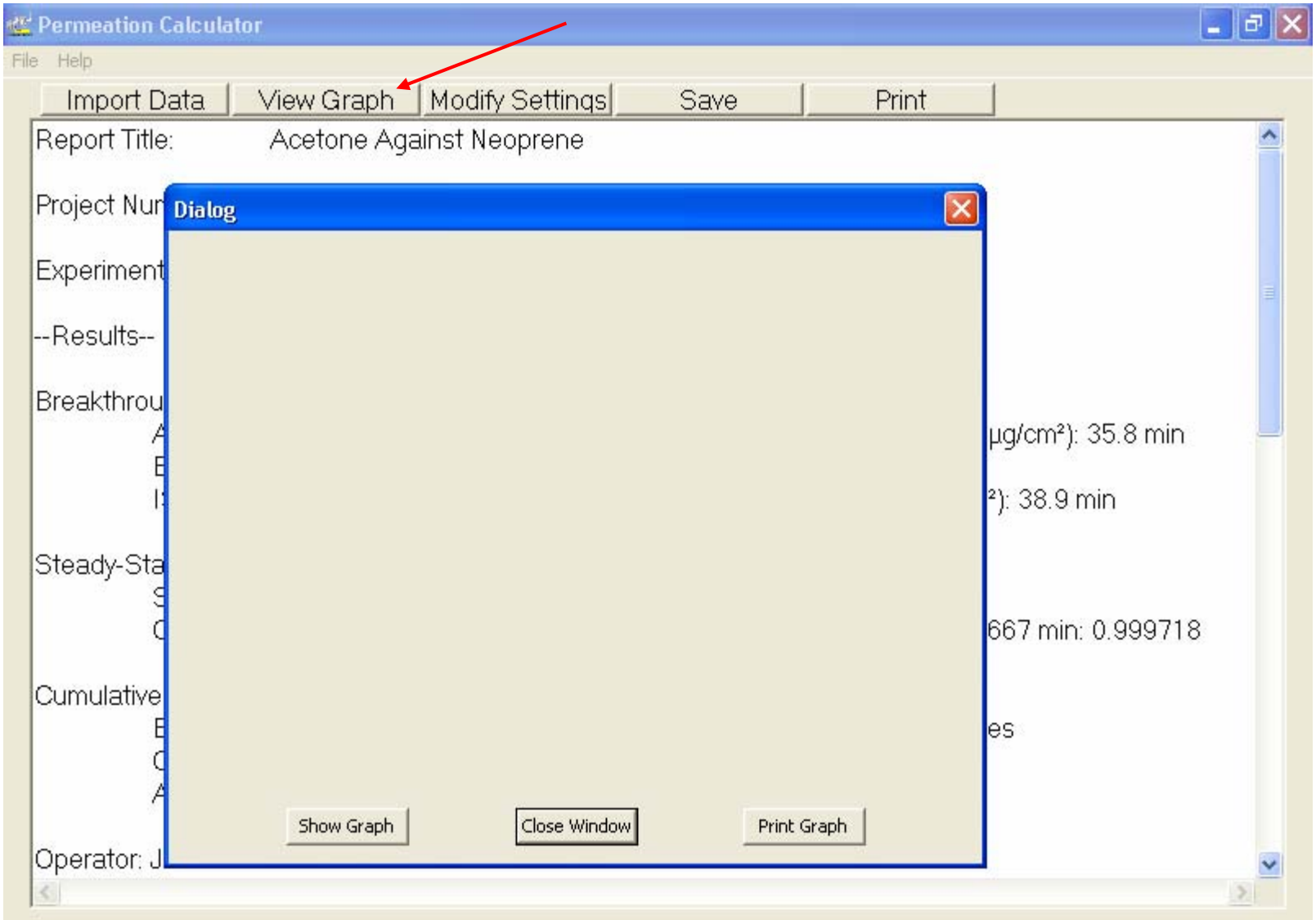

Permeation Calculator
File Help
Import Data
View Graph
Modify Settings
Save
Print
Report Title: Acetone Against Neoprene
Choice of Variable
* All active fields are required data fields unless noted as optional
Manual Data Columns Selected
Analyzer Response Format
Option 1: Use Concentration (in µg/L)
Option 2: Use Concentration (in ppm)
Option 3: Use Other Analyzer Output Reading
Time Format
Time in Minutes
YYYY/MM/DD HH:MM:SS
MM/DD/YYYY HH:MM:SS ##
Choose System Type
Open Loop System (OL)
Constant Flow Rate of Fresh Collection Medium (F in ASTM F 739):
3.94
L / min
Analytical Method Detection Limit:
µg/mL (optional)
Variable Flow Rate.
Minimum detectable permeation rate:
0.10
µg/(cm²*min)
Closed Loop System (CL)
Total Volume of the Collection Medium (Vt in ASTM F 739):
5.64
L
Continuous Sampling
Discrete Sampling
Sample Volume NOT replaced, enter Volume Removed (Vs in ASTM F 739)
0.05
L
Sample Volume IS replaced, enter Volume Replaced (Vs in ASTM F 739)
0.05
L
Minimum detectable mass permeated:
0.25
µg/cm²
Cancel
Next

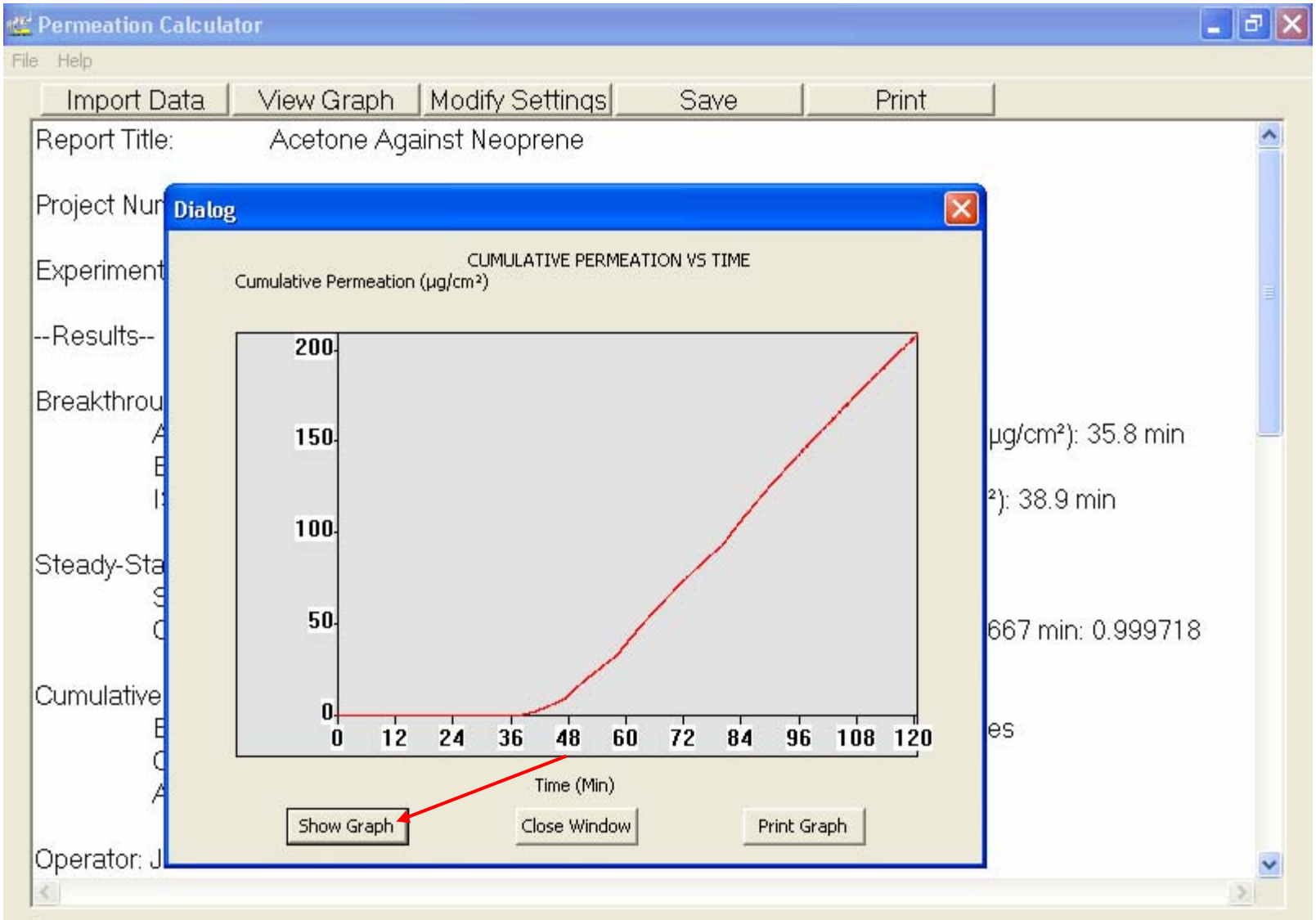

Permeation Calculator
File
Help
Import Data
Modify Settings
View Results Graph
Save
Print
Exit
View Graph
Modify Settings
Save
Print
Acetone Against Neoprene
PR-1234
Closed Loop, Continuous Sampling.
--Results--
Breakthrough Time--
ASTM F739 Standardized Breakthrough Time (permeation mass at 0.25 µg/cm²): 35.8 min
Breakthrough Detection Time (BDT): 36.06489 min
ISO 6529 Normalized Breakthrough Time (permeation mass at 2.5 µg/cm²): 38.9 min
Steady-State Permeation Rate (SSPR)--
SSPR: 2.74 µg/(cm²*min)
Correlation Factor (R²) in the steady-state region from 93.51667 to 108.8667 min: 0.999718
Cumulative Permeation--
Elapsed Time for Cumulative Permeation Mass of 150 µg/cm²: 98.3 minutes
Cumulative Permeation for 60 minutes: 39.9 µg/cm²
Average Permeation Rate from 0.00 to 120.83 min: 1.73 µg/(cm²*min)
Operator: Jane Doe


Permeation Calculator
File Help
Import Data
View Graph
Modify Settings
Save
Print
Report Title: Acetone Against Neoprene
Project Number: PR-1234
Experiment type: Closed Loop, Continuous Sampling.
--Results--
Breakthrough Time--
ASTM F739 Standardized Breakthrough Time (permeation mass at 0.25 µg/cm²): 35.8 min
Breakthrough Detection Time (BDT): 36.06489 min
ISO 6529 Normalized Breakthrough Time (permeation mass at 2.5 µg/cm²): 38.9 min
Steady-State Permeation Rate (SSPR)--
SSPR: 2.74 µg/(cm²*min)
Correlation Factor (R²) in the steady-state region from 93.51667 to 108.8667 min: 0.999718
Cumulative Permeation--
Elapsed Time for Cumulative Permeation Mass of 150 µg/cm²: 98.3 minutes
Cumulative Permeation for 60 minutes: 39.9 µg/cm²
Average Permeation Rate from 0.00 to 120.83 min: 1.73 µg/(cm²*min)
Operator: Jane Doe


Permeation Calculator
File Help
Import Data
View Graph
Modify Settings
Save
Print
Report Title: Acetone Against Neoprene
Project Number:
Experiment type:
--Results--
Breakthrough Time--
ASTM F739
ISO 6529
Steady-State Permeati
Correlation
Cumulative Permeation
Elapsed Time
Cumulative Permeation for 60 minutes: 39.9 µg/cm²
Average Permeation Rate from 0.00 to 120.83 min: 1.73 µg/(cm²*min)
Operator: Jane Doe
Print
Printer
Name: \\pnio-pitt-1.niosh.cdc.gov\B013-Hall HPL
Properties...
Status: Ready
Type: HP Color LaserJet 4650 PS
Where: Pittsburgh B013-Hall HPLaser4650
Comment: B013-Hall HPLaser4650
Print range
All
Pages from: to:
Selection
Copies
Number of copies: 1
Collate
Help
OK
Cancel
start
Inbox - Mi...
Microsoft ...
Permeatio...
2:24 PM


Permeation Calculator
File
Help
Import Data
Modify Settings
View Results Graph
Save
Print
Exit
View Graph
Modify Settings
Save
Print
Acetone Against Neoprene
PR-1234
Closed Loop, Continuous Sampling.
--Results--
Breakthrough Time--
ASTM F739 Standardized Breakthrough Time (permeation mass at 0.25 µg/cm²): 35.8 min
Breakthrough Detection Time (BDT): 36.06489 min
ISO 6529 Normalized Breakthrough Time (permeation mass at 2.5 µg/cm²): 38.9 min
Steady-State Permeation Rate (SSPR)--
SSPR: 2.74 µg/(cm²*min)
Correlation Factor (R²) in the steady-state region from 93.51667 to 108.8667 min: 0.999718
Cumulative Permeation--
Elapsed Time for Cumulative Permeation Mass of 150 µg/cm²: 98.3 minutes
Cumulative Permeation for 60 minutes: 39.9 µg/cm²
Average Permeation Rate from 0.00 to 120.83 min: 1.73 µg/(cm²*min)
Operator: Jane Doe


Permeation Calculator
File Help
Import Data
View Graph
Modify Settings
Save
Print
Report Title: Acetone Against Neoprene
Project Nur
Experiment
--Results--
Breakthrou
µg/cm²): 35.8 min
²): 38.9 min
Steady-Sta
667 min: 0.999718
Cumulative
es
Operator: J
Dialog
Show Graph
Close Window
Print Graph


Permeation Calculator
File Help
Import Data
View Graph
Modify Settings
Save
Print
Report Title: Acetone Against Neoprene
Project Nur
Experiment
--Results--
Breakthrou
Steady-Sta
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Operator: J
Dialog
CUMULATIVE PERMEATION VS TIME
Cumulative Permeation (µg/cm²)
200
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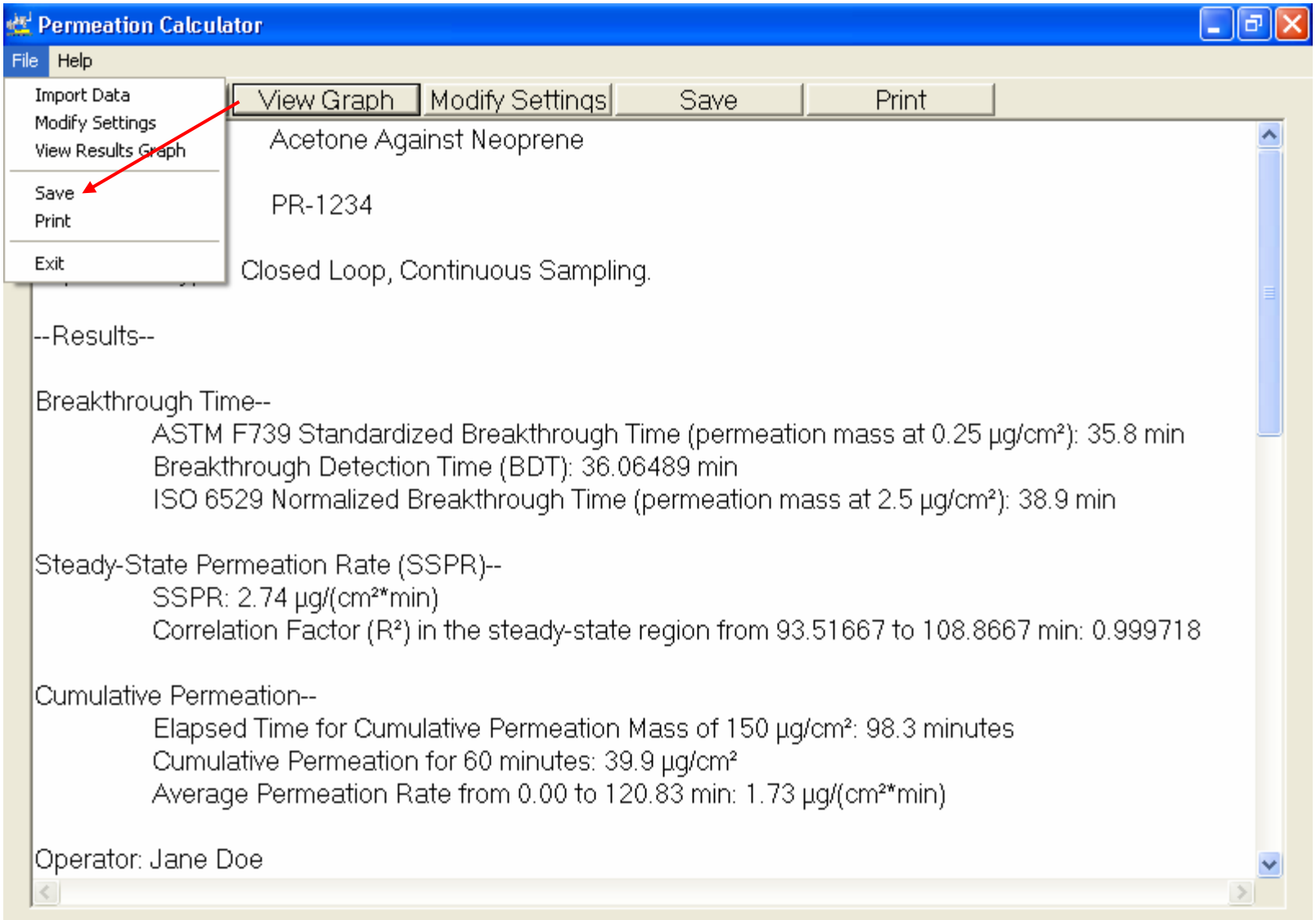
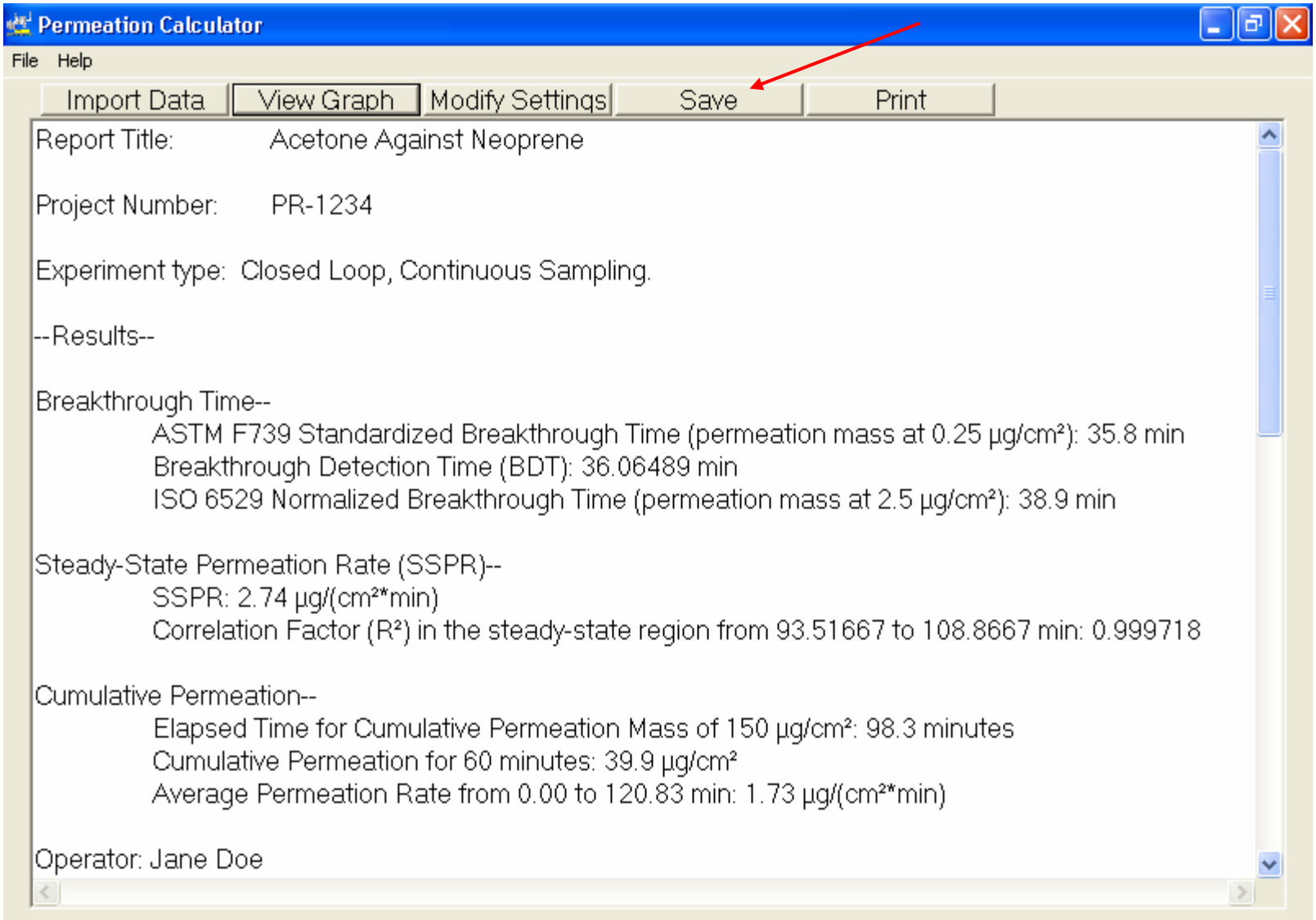
100
50
0
0 12 24 36 48 60 72 84 96 108 120
Time (Min)
Show Graph
Close Window
Print Graph
µg/cm²): 35.8 min
²): 38.9 min
667 min: 0.999718
es


Permeation Calculator
File
Help
Import Data
Modify Settings
View Results Graph
Save
Print
Exit
View Graph
Modify Settings
Save
Print
Acetone Against Neoprene
PR-1234
Closed Loop, Continuous Sampling.
--Results--
Breakthrough Time--
ASTM F739 Standardized Breakthrough Time (permeation mass at 0.25 µg/cm²): 35.8 min
Breakthrough Detection Time (BDT): 36.06489 min
ISO 6529 Normalized Breakthrough Time (permeation mass at 2.5 µg/cm²): 38.9 min
Steady-State Permeation Rate (SSPR)--
SSPR: 2.74 µg/(cm²*min)
Correlation Factor (R²) in the steady-state region from 93.51667 to 108.8667 min: 0.999718
Cumulative Permeation--
Elapsed Time for Cumulative Permeation Mass of 150 µg/cm²: 98.3 minutes
Cumulative Permeation for 60 minutes: 39.9 µg/cm²
Average Permeation Rate from 0.00 to 120.83 min: 1.73 µg/(cm²*min)
Operator: Jane Doe


Permeation Calculator
File Help
Import Data
View Graph
Modify Settings
Save
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Report Title: Acetone Against Neoprene
Project Number: PR-1234
Experiment type: Closed Loop, Continuous Sampling.
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Breakthrough Time--
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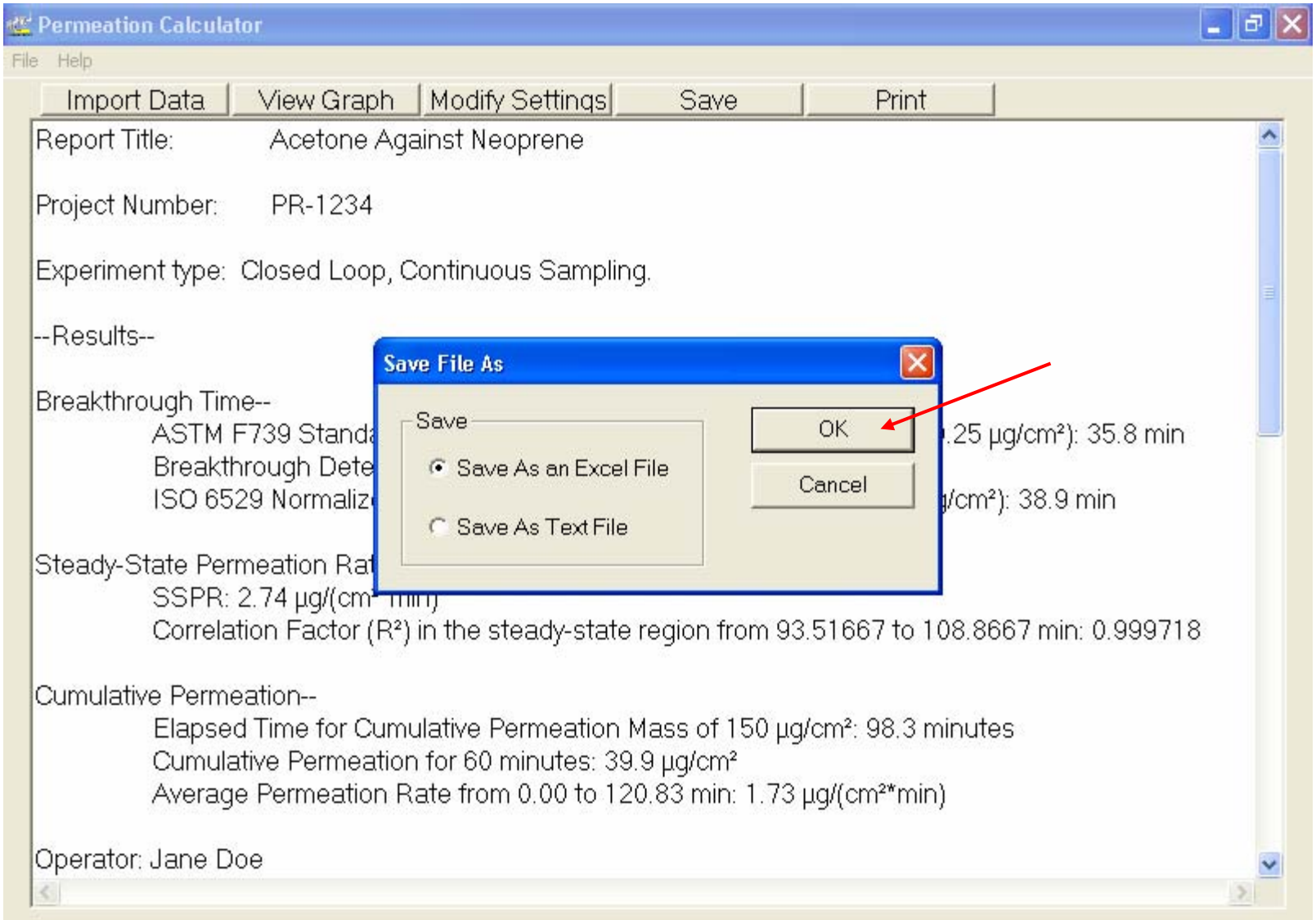
Operator: Jane Doe


Permeation Calculator
File Help
Import Data
View Graph
Modify Settings
Save
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Report Title: Acetone Against Neoprene
Project Number: PR-1234
Experiment type: Closed Loop, Continuous Sampling.
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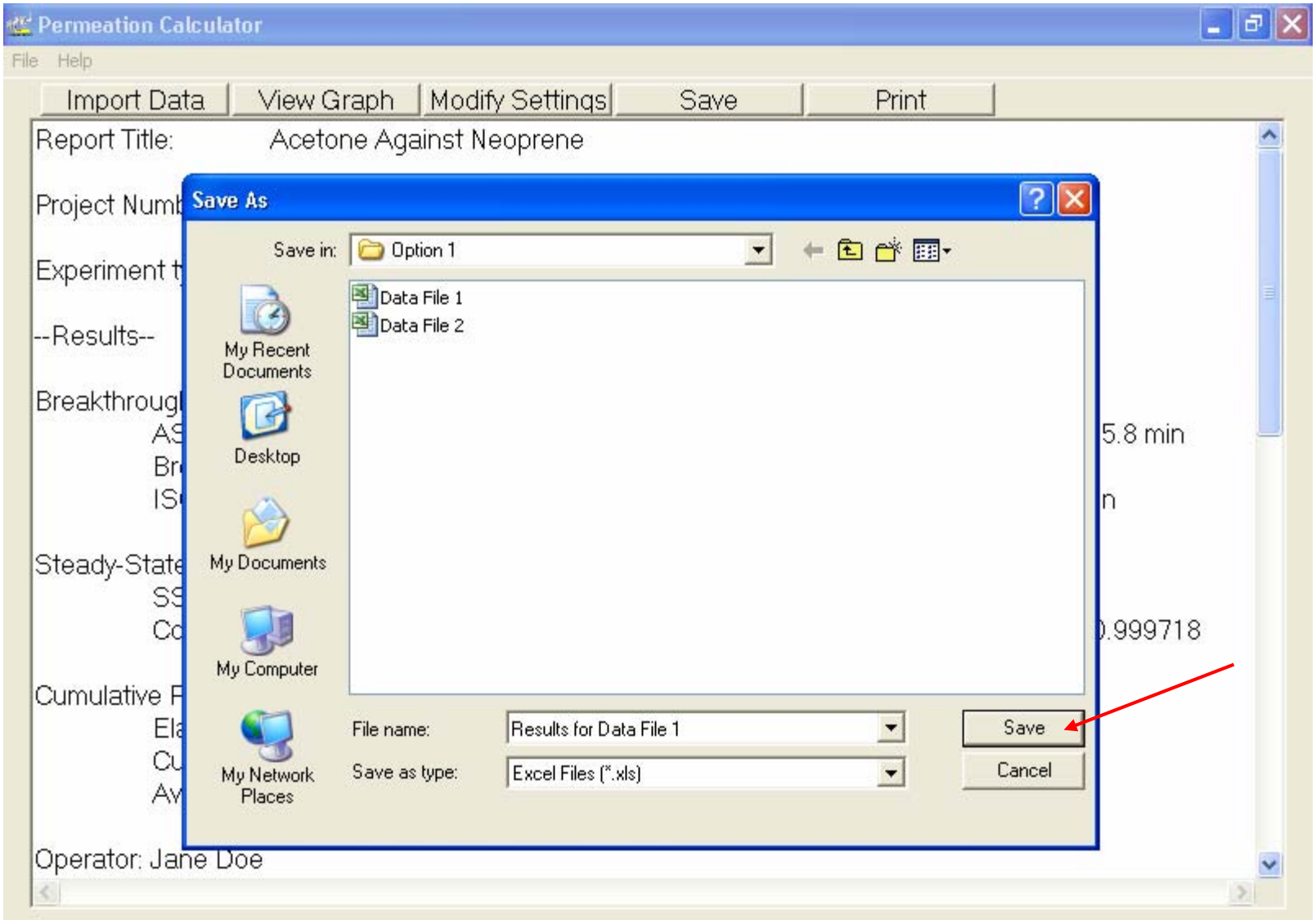
Operator: Jane Doe
Save File As
Save
Save As an Excel File
Save As Text File
OK
Cancel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Operator: Jane Doe
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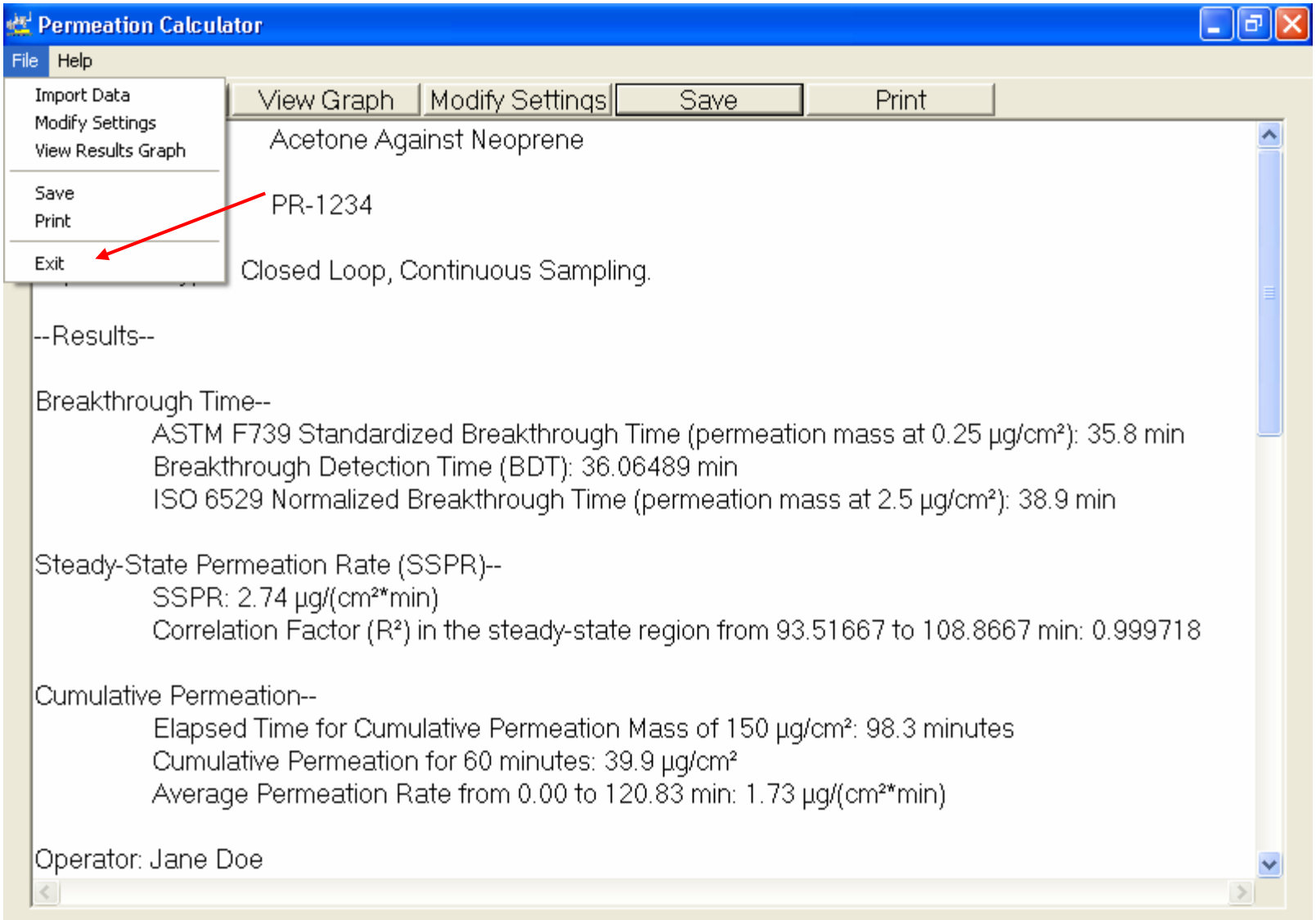
Save in: Option 1
Data File 1
Data File 2
My Recent Documents
Desktop
My Documents
My Computer
My Network Places
File name: Results for Data File 1
Save as type: Excel Files (*.xls)
Save
Cancel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Acetone Against Neoprene
PR-1234
Closed Loop, Continuous Sampling.
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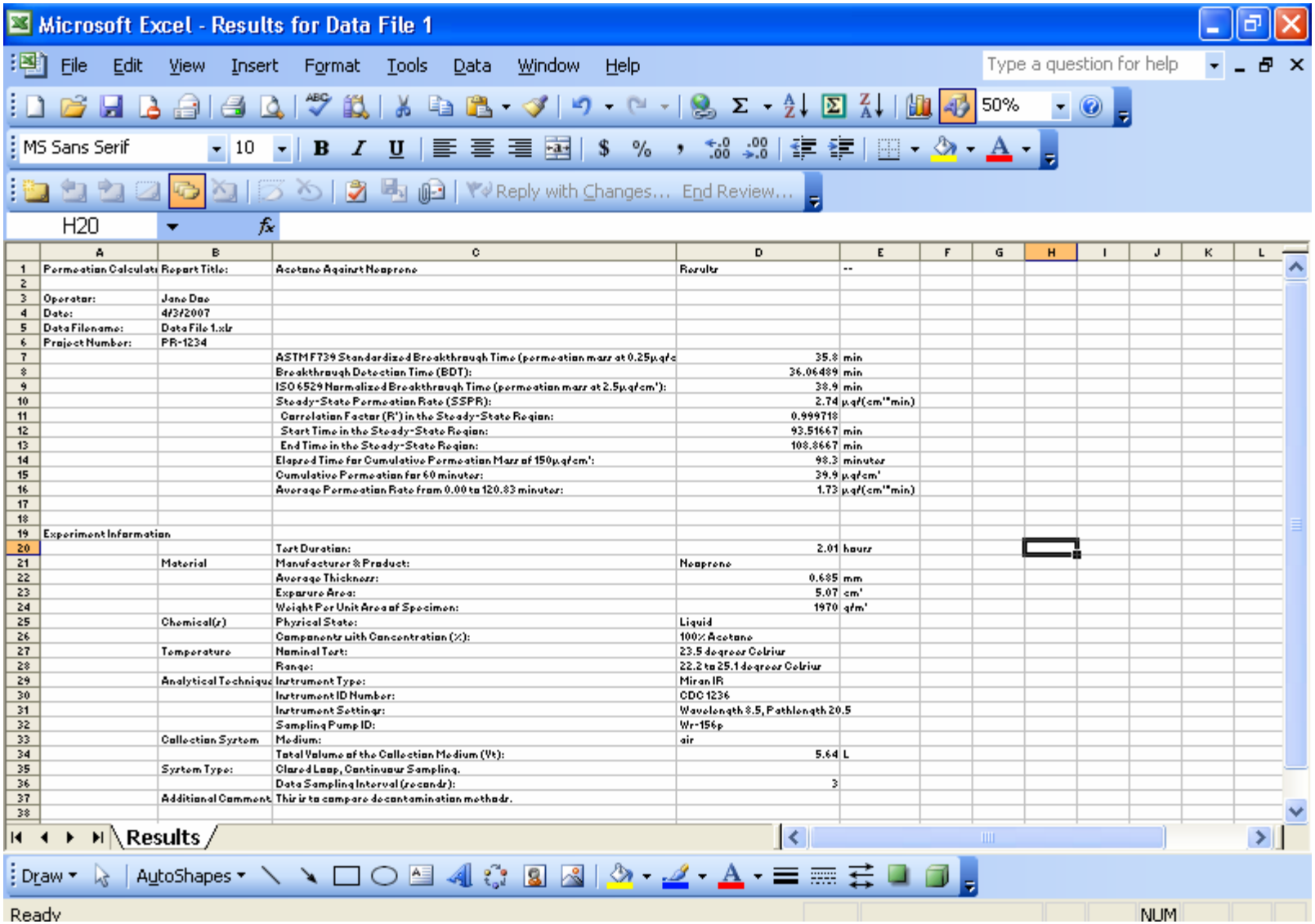
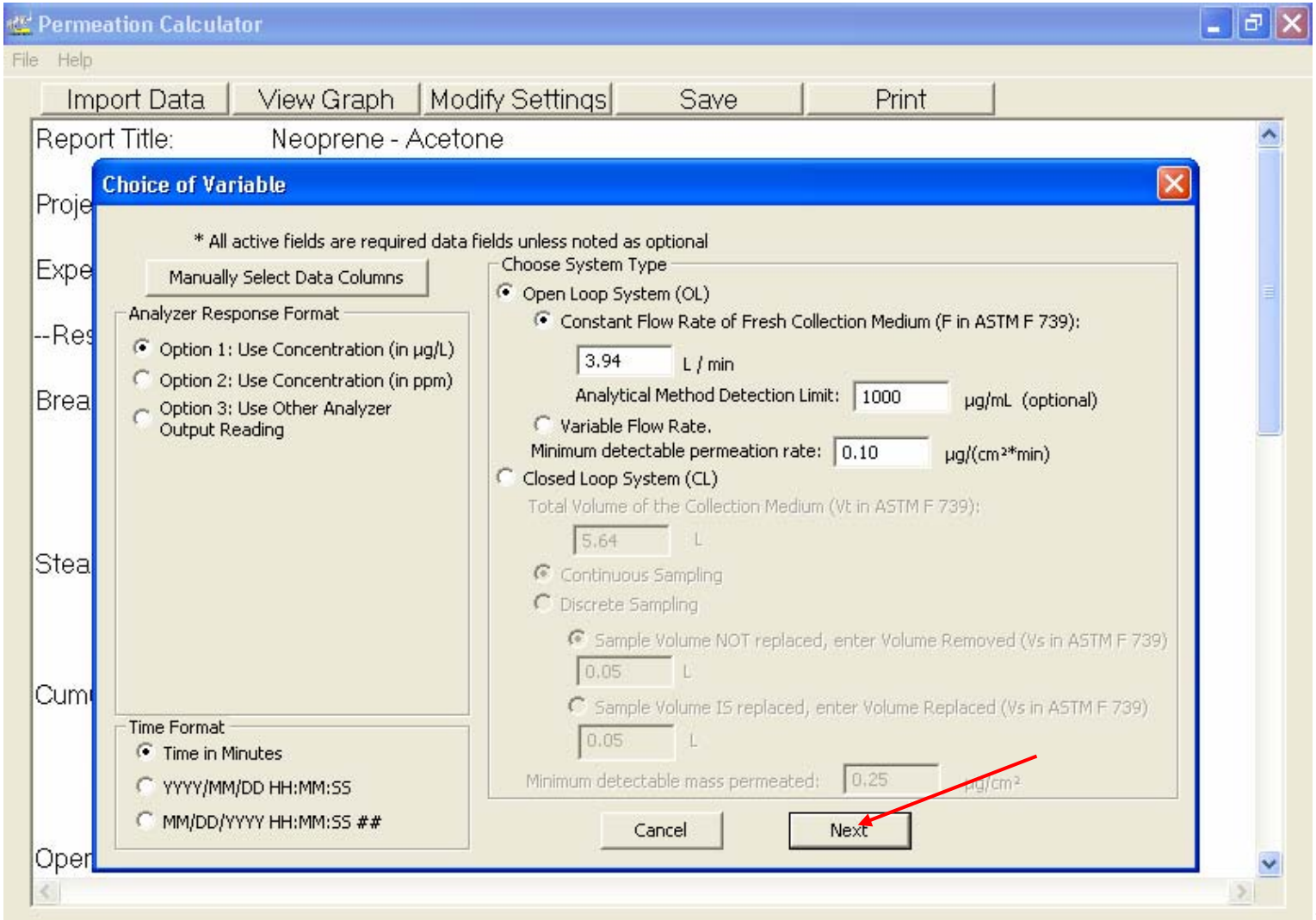
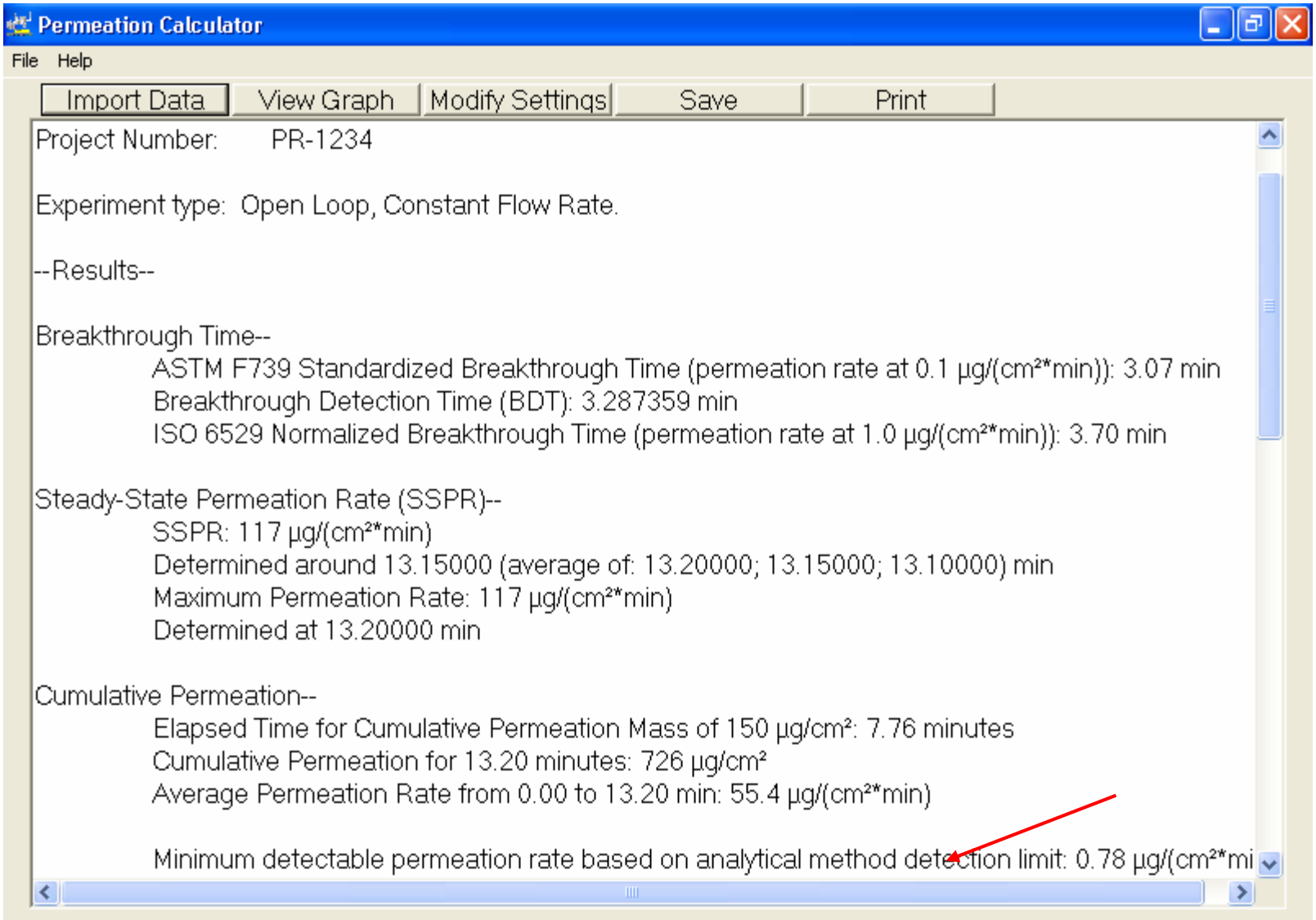
Operator: Jane Doe



	A	B	C	D	E
1	Permeation Calculati	Report Title:	Acetone Against Neoprene	Results	--
2					
3	Operator:	Jane Doe			
4	Date:	4/3/2007			
5	Data Filename:	Data File 1.xls			
6	Project Number:	PR-1234			
7			ASTMF739 Standardized Breakthrough Time (permeation rate at 0.25µg/c	35.8	min
8			Breakthrough Detection Time (BDT):	36.06489	min
9			ISO 6529 Normalized Breakthrough Time (permeation rate at 2.5µg/cm²):	38.9	min
10			Steady-State Permeation Rate (SSPR):	2.74	µg/(cm²*min)
11			Correlation Factor (R²) in the Steady-State Region:	0.999718	
12			Start Time in the Steady-State Region:	93.51667	min
13			End Time in the Steady-State Region:	108.8667	min
14			Elapsed Time for Cumulative Permeation Mass of 150µg/cm²:	98.3	minutes
15			Cumulative Permeation for 60 minutes:	39.9	µg/cm²
16			Average Permeation Rate from 0.00 to 120.83 minutes:	1.73	µg/(cm²*min)
17					
18					
19	Experiment Information				
20			Test Duration:	2.01	hours
21		Material	Manufacturer & Product:	Neoprene	
22			Average Thickness:	0.685	mm
23			Exposure Area:	5.07	cm²
24			Weight Per Unit Area of Specimen:	1970	g/m²
25		Chemical(s)	Physical State:	Liquid	
26			Components with Concentration (%):	100% Acetone	
27		Temperature	Nominal Test:	23.5 degrees Celsius	
28			Range:	22.2 to 25.1 degrees Celsius	
29		Analytical Techniqu	Instrument Type:	Miran IR	
30			Instrument ID Number:	CDC 1236	
31			Instrument Settings:	Wavelength 8.5, Pathlength 20.5	
32			Sampling Pump ID:	Wr-156p	
33		Collection System	Medium:	air	
34			Total Volume of the Collection Medium (Vt):	5.64	L
35		System Type:	Closed Loop, Continuous Sampling.		
36			Data Sampling Interval (seconds):	3	
37		Additional Comment	This is to compare decontamination methods.		
38					

For open loop testing under a constant flow rate, there is an option to enter a value for the “Analytical Method Detection Limit” to calculate the “Minimum Detectable Permeation Rate” (see the report on the next slide)




Permeation Calculator
File Help
Import Data
View Graph
Modify Settings
Save
Print
Project Number: PR-1234
Experiment type: Open Loop, Constant Flow Rate.
--Results--
Breakthrough Time--
ASTM F739 Standardized Breakthrough Time (permeation rate at 0.1 µg/(cm²*min)): 3.07 min
Breakthrough Detection Time (BDT): 3.287359 min
ISO 6529 Normalized Breakthrough Time (permeation rate at 1.0 µg/(cm²*min)): 3.70 min
Steady-State Permeation Rate (SSPR)--
SSPR: 117 µg/(cm²*min)
Determined around 13.15000 (average of: 13.20000; 13.15000; 13.10000) min
Maximum Permeation Rate: 117 µg/(cm²*min)
Determined at 13.20000 min
Cumulative Permeation--
Elapsed Time for Cumulative Permeation Mass of 150 µg/cm²: 7.76 minutes
Cumulative Permeation for 13.20 minutes: 726 µg/cm²
Average Permeation Rate from 0.00 to 13.20 min: 55.4 µg/(cm²*min)
Minimum detectable permeation rate based on analytical method detection limit: 0.78 µg/(cm²*mi